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FISHERY ASSESSMENT REPORT

TASMANIAN ABALONE FISHERY

2008

Compiled by David Tarbath and Caleb Gardner

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This report was compiled by D. Tarbath and Caleb Gardner
TAFI Marine Research Laboratories, PO BOX 252-49, Hobart, TAS 7001, Australia.
E-mail: David.Tarbath@utas.edu.au.
Ph. (03) 6227 7277, Fax (03) 6227 8035

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Abalone Fishery Assessment: 2008

Executive summary

Abalone landings to the end of 2008 were 2,461t of blacklip (*Haliotis rubra*) and 122t of greenlip (*H. laevigata*), amounting to a total of 2,583t. This was 10.5t below the TAC of 2,593.5t but represented an increase in catch of almost 150t over the previous year. The increase in catch was due to TAC increases of 38.5t in the Eastern Zone, 52.5t in the Northern Zone and the reopening of the Bass Strait Zone following its closure in 2007.

The 2008 catch had a gross landed value of $90 million, which was approximately $8 million less than the previous year. Consequently the royalties collected by the Tasmanian government were $6.2 million, down from the $7.3 million collected in the previous year.

The fishery is assessed primarily on commercial catch, effort and size-composition data from the commercial fishery. Annual variation in catch rate was interpreted as a relative index of abalone abundance. Interpretation of catch-rate trends was assisted by changes in median length of commercial catch. In addition, consultation with the abalone industry was undertaken to obtain their observations on the state of the stocks and market drivers affecting the operation of the fishery throughout 2008.

In summary, the major findings of this assessment are provided for each fishing zone as follows:

Eastern Zone

Annual catch from the Actaeons (Sub-blocks 13C-13E) increased by more than 20% in 2008, which implies that this area absorbed most of the increase in TAC for this zone. Divers reported shifting their operations from the East Coast and Storm Bay to the Actaeons to take advantage of the higher catch rates and more consistent fishing conditions. The large catch in conjunction with consistently high catch rates in the Actaeons indicate that stock levels in 2008 were stable.

North of Southport, the Lower Channel (Sub-blocks 14A-14D) was closed to fishing as a precautionary measure to control the spread of Abalone Viral Gangleoneuritis (AVG). Drivers of trends in catch in this area are complicated – the closure clearly had an impact but there also appeared to be a shift in effort away from the region due to lower catch rates.

While Bruny Island (Blocks 14C-16) catch rates fell for the second successive year they remained in the upper range of catch rates seen over the last decade. However, this would be expected given that the annual catch from this region has trended downwards in recent years, and is now at low levels. The abundance of recruits in the catch exhibited no clear trend, and there was no evidence that stocks were rebuilding.

In Storm Bay (Blocks 17-22), the annual catch has fallen for several years, although catch rates from parts of this region remained among the highest in the Eastern Zone. Stocks in this region appeared stable, with no clear signs of an increase or decrease.

Trends in some blocks of the fishery between Tasman Island and the Northern Zone boundary (East Coast region – Blocks 22-31) continue to be of concern. Catch rates fell across the broader region in 2008 for the second successive year despite reduced catch. While catch rates remained at moderate levels, the trends in this area should be monitored closely as further falls could require management action.

Western Zone

North Western (Block 6) catch rates improved markedly following the 4-mm reduction in size limit, but the annual catch remained low because processors preferred fish from other regions. The size-limit change meant that inter-annual trends in catch and catch-rate data were uninformative on stock trends. Some guidance comes from the south of Block 6 where size limits were unchanged. In this area the catch rates also increased, supporting divers' observations that recruitment had increased in the area.

In the Central West north of Strahan (Blocks 7-8) stock levels appeared stable or increasing, with catch slightly lower than previous years. South of Strahan (Block 9), catch rates and information from divers indicated that the stock was under pressure. Abalone from this part of the zone attracted lower beach prices, which drove effort away from the region.

Further south, in the South West (Blocks 10-11) stock levels appear reduced with a long term trend of declining that continued in 2008.

On the South Coast (Sub-blocks 12B - 13B), catch rates appeared stable. However, the 2008 annual catch was the largest since the introduction of quota management in 1985, and it seems unlikely that annual catches of this magnitude could continue to be taken without substantial declines in catch rate.

Harvest simulation modelling predicted that a continuation of fishing at 2008 levels would be unsustainable and that catches in the Western Zone south of Strahan would need to be reduced below 900t pa to provide a 50% probability that stocks would rebuild. To address this issue in 2009 the old Western Zone was split into two new zones: north of Strahan (Central Western Zone), and south of Strahan (Western Zone). Catch was reduced in the new Western Zone, and increased in the Central Western Zone. The combined TAC of the new Western and Central West Zones is now 2.5% less than the old Western Zone TAC. While the creation of the two new zones will assist with the spatial dispersal of effort, the TAC for the new Western Zone will need to be monitored and adjusted if the aim is to stabilise catch rates.

Northern Zone

Effort on King Island (Blocks 1-4) was low following the implementation of quarantine provisions to manage the risks relating to AVG in 2006. Consequently, the annual catch has fallen and catch rates have risen.

In Block 5 in the North West, the size limit was reduced and the block cap increased by more than 50% to enable fishing of smaller-growing populations. Catch rates increased sharply as a consequence of the sudden increase in available stock. In Block 49, catch levels and catch rates indicated that stock levels were stable.

In the North East (Blocks 31, 39-41), there was a large decline in catch rates following the unusually high 2007 catch. However, there was no clear indication whether stock levels had stabilised or were continuing to decline. The Northern Zone part of the Furneaux Group (Blocks 32-36, 38) provides small quantities of catch each year. The nature of the fishing here meant that catch rates were not reliable indicators of abundance. Divers have periodically reported quantities of blacklip, including populations too small to harvest at current size limits.

Bass Strait Zone

The Bass Strait blacklip fishery was reopened in 2008 after being closed during 2007 and part of 2006 as a precautionary measure to prevent the spread of AVG from Victorian waters to the Tasmanian fishery. This closure appears to have stabilised catch rates in the Furneaux Group (Block 37) and remote islands closer to Victoria (Blocks 50-56). On Tasmania's north coast (Blocks 42-46), catches were small and populations were slow to recover following fishing.

Greenlip

Greenlip stocks appeared to be stable throughout the fishery. For various reasons, catch rates are less reliable indicators of abundance in this fishery than with blacklip, and observations of divers are especially important in interpreting trends in fishery-dependent data. On King Island, the North East and parts of the North West coast, stock levels were stable, albeit at low levels. In the Furneaux Group, stocks continued to rebuild from the low levels of the 1990's.

At Perkins Bay (Blocks 47, 48A) in the North West where in 2006 the size limit was reduced from 145mm to 132mm, both catch rates and divers' reports indicated that stock levels were high. However, the large reduction in size limit was recommended with the proviso that fishing be distributed across all reefs in Perkins Bay, and catch be limited to 20t. Since the size limit reduction, all fishing has been done at Black Reef (i.e. not distributed), and in 2008, the catch exceeded 20t. This spatial concentration of catch increases the risk of a future decline in catch rates.

Recreational and other fisheries

Recreational catch was most recently estimated through a survey in 2007. That survey indicated that 105,500 abalone were taken in 2006/07, weighing an estimated 49t. The number of recreational abalone licenses has increased by an average of approximately 10% annually since the 1995-96 season and in the 2007/08 season, 13,538 recreational abalone diving licenses were issued. By inference, the 2007/08 catch was approximately 54t.

Abalone were caught in Tasmanian waters as part of cultural fishing activities by indigenous people, under permits for special events and research purposes, and as part of illegal fishing operations. There were no estimates available for either the illegal catch or for the total catch from cultural fishing activities. The quantity of abalone taken under permits for special events and research purposes was less than one tonne.

Summary of Recommendations:

Eastern Zone: From 2008, an annual 5% increase in TAC for the Eastern Zone was implemented conditional on ongoing improvement in performance of the Eastern Zone fishery. While there are regions within the Eastern Zone that appeared to be stable (e.g. Actaeons and Storm Bay), other areas appeared less resilient to higher levels of catch (e.g. Bruny Island, East Coast). Managing the spatial distribution of catch appears critical if the 5% increase in Eastern Zone TAC for 2010 is to be implemented. Stock levels in Block 31 appeared high with low exploitation rates due to market pressures from processors. Development of options to increase harvests in this block would assist in reducing catch in other areas of the zone.

Western Zone: For the 2009 fishing year, the TAC from the new Western Zone (Blocks 9-13) was reduced to 924t. Model projections for Blocks 9-13 suggest that there is a greater than 50% probability of decline with this TAC and that for catch-rate increases to occur, the TAC would need to be reduced to below 900t. Distribution of catch within the Western Zone was uneven, with catch in Block 6 remaining low (i.e. stock levels relatively high) despite the reduced size limit, because catch was taken from further south due to market pressures.

Northern Zone: The King Island blacklip catch has dropped substantially, and while this has increased stock levels in the region, it likely that greater levels of catch could be sustained. The major impediments to increased catch were the quarantine movement restrictions, difficulties and costs associated with operating from the island, and weak demand for its product. It is recommended that this part of the fishery be reviewed, and options developed to increase the contribution of this region to the Northern Zone catch, and to reduce catch in the North East.

Greenlip fishery: Use of fishery data to monitor stock levels in both the Northern Zone and Greenlip fishery is compromised by the way that divers report effort when fishing for both species in a single trip. It is recommended that a standard method of reporting effort be developed so that changes in catch rates would become more useful indicators of abundance.

In general: The challenge in management of the Tasmanian abalone stocks remains the management of the spatial distribution of catch. It appears that catches in some blocks (e.g. 6 and 31) could be increased but these areas are being avoided by divers due to poor market traits. This comes at the cost of lost opportunity plus greater potential for excess catch in other areas. Attempts to manage spatial distribution of catch in the Western Zone have only been partially successful and further exploration of spatial management tools is suggested.

Contents

1. Introduction

This assessment relies wholly on fishery-dependent data. Principally, changes in catch and catch rate have been used to make inferences about changes in abalone abundance. This has been supplemented with information from a secondary source: changes in the median length of abalone sampled from the commercial catch and grouped across relatively fine spatial scales. Combined with changes in median length, trends in catch rates can be useful indicators of changes in abalone populations in Tasmania.

The use of catch and catch rates to monitor changes in abalone abundance has often been criticised as unreliable and elsewhere is infrequently used. In theory, the fishing of abalone aggregations, serial depletion and changes in fishing efficiency reduce the link between catch rates and abundance. These factors are considered more problematic in areas where effort and catch are low.

However, when abalone populations are intensively fished, as occurs throughout much of the Tasmanian fishery, catch and catch rate trends appear to be reliable indicators of changes in abundance. When fishing pressure is sufficient, aggregations are unable to develop, and high visitation rates prevent stock build up and subsequent serial depletion. The confounding effects of effort creep may be reduced by using short-term (10 years or less) catch and catch-rate trends to assess changes in stock levels. Under these circumstances, catch and catch-rate trends appear to reflect changes in abundance.

This document makes use of fisheries data collated over progressively diminishing spatial scales. The top level scale is the zone. The use of zones was first introduced into the Tasmanian fishery in 2000, to control falling stock levels by managing the spatial distribution of catch. Since 2003, the Tasmanian blacklip fishery has been divided into four zones: Eastern, Western, Northern and Bass Strait. A fifth zone (Central West) will apply from 2009. The greenlip abalone fishery is managed separately from the blacklip fishery. The greenlip fishery is restricted to the north of the state, and the spatial distribution of its catch is managed by regions.

Whilst zones are now the established method of managing the fishery, they mask details important for fishery assessment. Zones are too large and include too many physical differences (*e.g.* water temperature regimes, geology, accessibility), and may include divergent recruitment patterns, and different levels of abundance and fishing methods. There is a risk that patterns in sub-sets of a zone may be very different to that for data pooled across the wider region. In this assessment, the risk is reduced by looking at fishing patterns across smaller regions which have a greater likelihood of sharing common fishing practises and stock levels.

The regions and region boundaries used in this assessment have been set arbitrarily, but are generally based upon commonly used Tasmanian regions, about which boundaries have been placed aligned with the abalone fishery reporting blocks. Where necessary, reference is made to the component blocks or sub-blocks within a region to help understand the performance of its fishery, with a proviso that the annual catch was 10t or more in any one of the years since 2000.

The zones, regions and statistical blocks from which the 2008 commercial catch was reported or which are referred to in this document are shown below (Figure 1; for sub-blocks see Appendix 11). Note that there will be changes to the Western Zone boundaries in 2009.

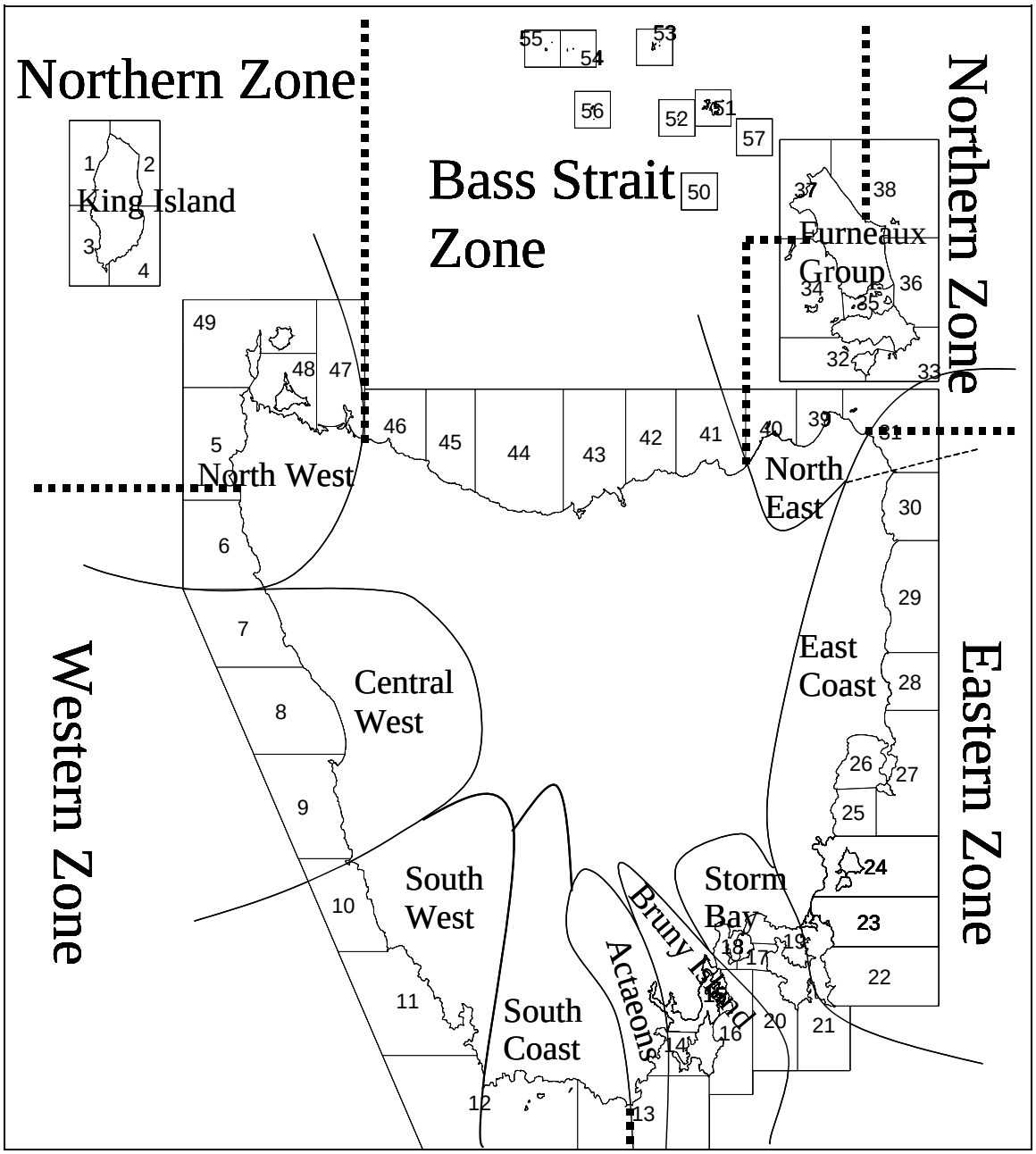


Figure 1. The zones and statistical blocks used in the Tasmanian abalone fishery in 2008. Also shown are the regions used for assessment purposes in this document. Zone boundaries are shown as dotted lines. The Greenlip fishery has no geographical boundaries, but mostly takes place on coasts included in the Northern and Bass Strait Zones. More detailed maps of catch reporting areas are shown in Appendix 11. There will be changes to the Western Zone boundaries in 2009.

The zone boundaries and their reporting blocks are as follows:

Zones
Eastern Zone: Whale Head to Great Musselroe River, Sub-blocks 13C, 13E, 13E, Blocks 14 to 30, Sub-blocks 31A, part of 31B.
Western Zone: Arthur River to Whale Head, Sub-block 5D, Blocks 6 to 12, Sub-blocks 13A, 13B.
Northern Zone: Arthur River to Cowrie Point including King Island, Anderson Bay to Great Musselroe River, Sub-blocks 5A, 5B, 5C, part of 31B, Blocks 39 to 40, Blocks 47 to 49. In the Furneaux Group, Blocks 32 to 36, Sub-block 38A.
Bass Strait Zone: Cowrie Point to Anderson Bay, Blocks 41 to 46, 50 to 57. In the Furneaux Group, Block 37, Sub-blocks 38B, 38C.

Catches from the greenlip fishery are reported by species *i.e.* the greenlip fishery has no spatial boundaries.

Regions
The regions used for the blacklip fishery in this document comprise the following reporting blocks:
Actaeons: Sub-blocks 13C, 13D, 13E, 14A, 14B
Bruny Island: Sub-blocks 14C, 14D, 14E, Blocks 15 and 16
Storm Bay: Blocks 17 to 21
East Coast: Blocks 22 to 30, Sub-blocks 31A, part of 31B (south of Great Musselroe River)
North East: Part of 31B (north of Great Musselroe River), Blocks 39 and 40
Furneaux Group (Northern Zone): Blocks 32 to 36, 38A
Furneaux Group (Bass Strait Zone): Block 37, 38B, 38C
Bass Strait Islands: Blocks 50 to 56
Central North Coast: Blocks 41 to 46
King Island: Blocks 1 to 4
North West (Northern Zone): Blocks 47 to 49, Sub-blocks 5A, 5B, 5C
North West (Western Zone): Sub-block 5D, Block 6
Central West: Blocks 7 to 9
South West: Blocks 10 to 11, Sub-block 12A
South Coast: Sub-blocks 12B, 12C, 12D, 13A, 13B

The Greenlip fishery is reported from the *North West* (Blocks 5, 47 to 49), *King Island* (Blocks 1 to 4), the *Furneaux Group* (Blocks 32 to 38) and the *North East* (Blocks 31, 39 and 40). Small catches are occasionally reported from the *Central North Coast* (Blocks 41 to 46) and the remote *Bass Strait islands* (Blocks 50 to 57).

This document contains charts of annual total catch and geometric mean catch rates, catch-rate distributions and annual median length. Important details about the use of these charts and the data from which they were produced are summarised here, (a more detailed explanation may be found in Appendix 1):

- The catches from all reported catches between 1975 and 2008 (inclusive) were used to estimate annual total catches *i.e.* no catches were omitted. The catch and effort database is known to contain duplicate, incorrect and incomplete records. These records are difficult to detect, but are corrected when they are encountered. Consequently, there may be minor variations in annual catch

reported in these documents from year to year. (See Appendix 9 for details of recent corrections.)

- Annual catch rates were derived from the geometric mean of individual catch rates, and not arithmetic means (averages), and all mean catch rates referred to in this document are geometric means. Geometric means are a more reliable estimator of the mean catch rate across all divers, because they are more consistent and less affected by variable skewness of distributions (*e.g.* where there are small but variable percentages of high catch rates). Only catch rates from catches of 40kg or more were considered when calculating catch-rate means (to reduce the effects of fishing events that were adversely affected by mechanical breakdown or calculating catch rates on the by-catch of fishing for different species).

- Catch-rate distribution charts show the distribution of catch rates across all divers *i.e.* the proportion of daily records having catch rates in categories grouped from low to high. By comparing the distribution of catch rates between recent years, it is possible to see where changes in catch rate have occurred, and the effect they have had on the mean catch rate.

- The annual median length of abalone, when viewed as a time series of data, is used to show changes in the length of abalone which may reflect changes in fishing pressure or levels of recruitment. Between 1998 and 2000, median length was derived from length measurements obtained from photographs of 25 abalone taken from divers' catches, photographed aboard divers' boats. Since 2000, median lengths were derived from samples of 100 measured abalone randomly selected from individual catches, and in most cases, sampling has been undertaken at factories. Since 2008, sampling has been undertaken by the larger processors on behalf of TAFI. Median lengths are deemed useful when more than 4% of catches in a reporting area have been sampled.

2. Assessment of the Tasmanian abalone fishery

The boundaries of zones, regions, blocks and sub-blocks used in this report are described in Section 1 (Introduction) or Appendix 11. For information about catch, catch rates and median length, see Section 3 (Catch, catch-rates and size-composition).

Landed catches and revenue - 2008

At the end of 2008, annual totals of reported landings comprised 2461.172t of blacklip and 122.061t of greenlip, a total of 2583.233t from a TAC of 2593.5t (Table 1). This represents an increase of almost 150t over the previous year, attributable to TAC increases of 38.5t in the Eastern Zone, 52.5t in the Northern Zone and the reopening of the Bass Strait Zone following its closure in 2007.

Processor returns indicate that the 2008 catch had a gross landed value of $89.9 million, down from the previous year's $97.8 million. Royalties collected by the Tasmanian government amounted to $6.2 million, also down on the previous year's $7.3 million. For comparison, the gross landed value reached $130 million in 2003, with royalties of over $15 million.

Table 1. 2008 landings by zone, in tonnes

Zone	2008 TAC (tonnes)	2008 landings (tonnes)
Greenlip	122.5	122.061
Eastern Blacklip	808.5	805.887
Northern Blacklip	332.5	330.888
Western Blacklip	1260	1255.025
Bass Strait Blacklip	70	69.372

Eastern Zone

Actaeons and Lower Channel (Sub-blocks 13C, 13D, 13E, 14A, 14B):

Fishery-dependent data
The catch from the Actaeons and Lower Channel increased by 22% to 356t in 2008. Of this, 340t was taken from sub-blocks 13C, 13D and 13E, an area for which an annual catch limit of 266t was set in October 2007. This part of the fishery was closed on 21 October 2008 for the remainder of the year.

The catch from the region was high relative to catches of previous years, although it is lower than the levels experienced during the late 1990's and early part of this century when estimated catches were over 400t. The average catch for this region was 283t (calculated using 80% of Block 13 catches and 30% of Block 14 catches between 1985 and 1999, then 13C to 14B catches between 2000 and 2007).

Most of the Actaeons catch comes from the reefs surrounding the two islands and the extensive reef system to their south in sub-block 13E. In 2008, this sub-block produced 287t, its highest level since 2000 when catches were first reported at the sub-block scale. To the west and south, levels of catch taken from sub-blocks 13D (28t) and 13C (26t) were more moderate, and within the range of recent years.

Much smaller amounts of catch came from the Lower Channel sub-blocks 14A and 14B. Between 16 September 2008 and 12 March 2009, part of the Lower Channel and south Bruny shores (specifically sub-blocks 14A, 14B, 14C and 14D) were closed to fishing as a precautionary measure to prevent the spread of AVG, and this prevented larger amounts of catch from being taken here. This closure may have reduced the reliability of using fishery-dependent data for assessment of the area in 2008. Prior to the closure, there was less effort in the area compared with earlier years. However, notwithstanding the effects of the closure, there appears to be a trend towards reduced catch levels in Block 14, including the coast from Dover to Southport Lagoon (sub-blocks 14A and14B). Both sub-blocks supplied between 15t and 20t for many years, but in 2008 produced 12t and 4t respectively.

Catch rates in sub-block 13E were stable (rose by 1kg/hr from 2007) at 87kg/hr, which is high relative to other blocks in the Eastern Zone. In 13C, catch rates fell from 101 to 92kg/hr from the previous year, and in 13D were stable (85kg/hr, down from 86kg/hr in 2007). In the Lower Channel sub-blocks, catch rates increased in 14A to 65kg/hr, but fell in 14B to 53/kg/hr. In both sub-blocks catch rates have trended upwards since 2002, but with inter-annual variability.

The median size of abalone from the region tended to increase, particularly in 13C. The median size in this sub-block fell between 2004 and 2006, but in 2008, both the median size and 25^{th} and 75^{th} percentiles increased sharply. In 13E, median size and the 75^{th} percentile length have both slowly trended larger since 2006. There was a 2-mm size limit increase in late 2006, which would at least partially account for a larger median size in 2007.

Diver perception

All divers reported good fishing at the Actaeons, and given the number of fish that they had seen on the reef, were optimistic that present conditions would continue. There was concern that the 266t cap was allowed to over run, and that the area was being subject to undesirably high levels of pressure, but catch rates remained stable nonetheless. Divers suggested that catch rates may have declined if fishing in the capped area had not been closed.

Qualitative assessment

One interpretation of the continuing increase in median size, particularly with increased catch rates, is that the period of time between attaining legal size and capture was increasing *i.e.* fishing pressure on stocks has fallen. However, in conjunction with the larger sized 25^{th} percentile, it may also indicate that there were less small fish being caught (recruitment was falling), and that stock levels could be expected to be lower in future.

In the part of the region that supplies most of the catch (Block 13), it is concluded that in 2008, the combination of high catch rates and increasing levels of catch and median size indicated that stock levels were probably stable.

Further north in Block 14, catch and catch rates were both low. Catch records between 1977 and 1991 supplemented with information supplied by early divers show that this area once supported much greater levels of catch, suggesting stock levels in this area are in a long-term decline.

Because effort was low, we are reluctant to attach any significance to annual variation in catch rates in 14A and14B, other than to report that catch rates were generally lower than the rest of the region.

Bruny Island (Sub-blocks 14C, 14D, 14E, Blocks 15 and 16):

Fishery-dependent data
The size of the 2008 catch from Bruny Island (105 t) was almost unchanged from the previous year, and low compared with historical catches. The 1985-2007 average catch was 186t (calculated using 70% of Block 14 catch up to 2000, plus catch from Blocks 15 and 16, then catch from 14C, 14D and 14E, plus Blocks 15 and 16 between 2000 and 2007).

The Channel side of Bruny, Blocks 15 (1t) and 14C (2t) contributed negligible amounts of catch. Most catch came from the southern Bruny shore, although the catches from sub-blocks 14D (10t) and 14E (29t) were also low relative to past years. Note that sub-blocks 14C and 14D were closed to fishing as a precaution against the spread of AVG between 16 September 2008 and 12 March 2009. On Bruny's eastern side, catches tended to be at relatively high levels in 16A (27t) and 16D (13t), but were reduced in 16B (15t) and 16C (10t).

Regional catch rates fell from a relatively stable 75kg/hr in 2006 and 2007, to 68kg/hr in 2008. The CPUE distribution shows a transition from the higher catch rate categories, particularly 100-125kg/hr, and an increase in the modal (75-100kg/hr) and lower order categories (25-50kg/hr). In the Channel (14C, 15), catch rates were below 50kg/hr. On the southern Bruny shore, catch rates in 14D and14E were 61kg/hr and 71kg/hr respectively, and trending downwards. On Bruny's east coast, catch rates were lower than in previous years, and while they were still high (80kg/hr) in 16A in the south, were only moderate (65kg/hr) in the remainder (16B, 16C, 16D).

Like the Actaeons, the median size and 75th percentile of length of abalone from most sub-blocks tended to increase, following a short period between 2004 and 2006 when the fish were smaller. Note that during some of the years the percentage of catches sampled was low, which gives low power to assess trends in length.

Diver perception
Divers were divided in their opinions about why catch rates were comparatively low around much of Bruny, compared with the Actaeons and Storm Bay. On one hand, those who fished mostly in 16A (the southern part of the east coast including the Strip where catch rates were high) were surprised that the rest of Bruny had not fished as well. From their perspective, Bruny was fishing as well as it had ever done, and stock

levels were satisfactory. They said that in 16A in particular, it was easy to miss the better quantities of abalone if divers unfamiliar with the area worked too far from the shore.

They speculated that the low catch rates were caused by unusually large numbers of divers being forced to fish Bruny in December after the Actaeons closure. Monthly catches for Bruny are shown in Figure 2 and these illustrate catch in December was moderate compared to other months of the year. Between 2000 and 2007, on average, 13% of Bruny's annual catch was taken in December, compared with 12% in 2008. In September and October, however, there was an increase in catch, probably caused by the AVG control measures, and this may have led to lower catch rates for the last two months of the year.

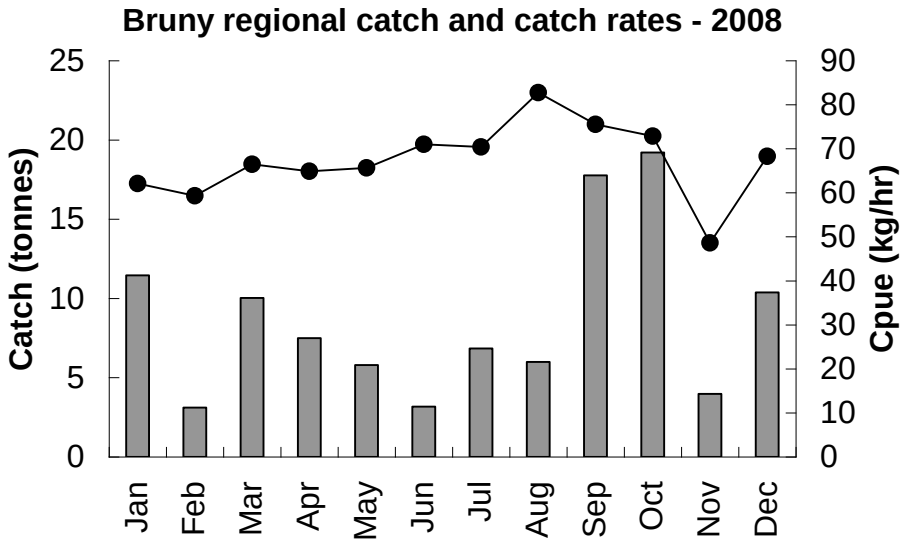


Figure 2. Monthly catch (tonnes) and mean catch rates (kg/hr), Bruny region, 2008.

Other divers believed that much of Bruny was not fishing as well as it had done in recent years. Many places such as Coal Point and Fluted Cape (16B), the coast between Cape Queen Elizabeth and Trumpeter Bay (16C), and the Friars (14E) produced smaller catches if other divers had worked there previously. They said that stocks in these areas were recovering only very slowly from what they termed heavy fishing pressure in 2006 and 2007. Furthermore, in south Bruny, almost all the abalone that were seen were of legal size *i.e.* few pre-recruits were visible.

Qualitative assessment
Because of the catch rate decline and the low annual catch, it appears that (a) the size of the stock was low, and (b) stocks were not rebuilding in the Bruny region as they have at the Actaeons. At best, stocks were stable. Given these observations it appears substantial increase in catch in the Bruny Island region should be avoided.

Storm Bay (Blocks 17-21):

Fishery-dependent data
The annual catch continued to fall, from a peak of 200t in 2005, to 120t in 2008. Compared with 2007, less catch came from the more exposed eastern side of Maingon

Bay in Block 21 (21C), and on the western side of the Tasman and Forestier Peninsulas (Blocks 17 and 20), catches also fell.

Catch rates were maintained at high levels, approximately 87kg/hr regionally and 97kg/hr in sub-block 21C. In all sub-blocks producing 10t or more in 2008, catch rates were greater than 80kg/hr, and were either stable or increasing.

The median size and 75th percentile length has tended to increase since 2004, particularly in sub-block 20A and in Block 21. The large increase in both percentiles in 20A is probably a response to the greatly reduced levels of catch and consequent reduction of fishing pressure there. In the past three years in 20A, catch levels have been reduced to a third of those of the previous three years. In all areas, part of this increase was due to the size limit increase first apparent in 2007.

Diver perception
It was reported that frequent westerly weather patterns made fishing on the eastern shores of Storm Bay (Blocks 17 and 20) difficult, and caused the annual catch to be lower than previous years. Some divers moved their operations to the Actaeons, because they could work more consistently there, and consequently effort (and catch) was reduced in the Storm Bay region. When the Actaeons was closed to fishing in mid-October, they returned to Storm Bay, and the catch increased (Figure 3).

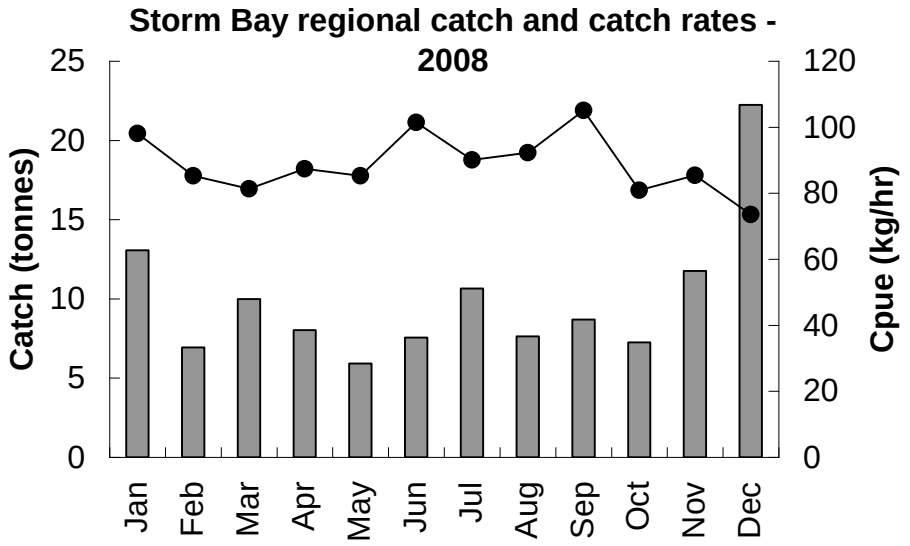


Figure 3. Monthly distribution of catch and catch rates, Storm Bay, 2008.

In Block 21, divers said that stocks in shallow water (<10m) have been reduced by fishing, and to maintain good catch rates, divers needed to work deeper where abalone were still abundant. However, the depth reduced fishing time and prevented divers from taking the larger catches that have been a feature of other parts of the fishery, such as the Actaeons.

Qualitative assessment
Catch rates in most parts of the region were high. Although the catch was relatively low, and has been falling. While localised shallow water depletion may be evident, it

appears that overall stocks in the region were stable, with no evidence to show either an increase or decrease.

East Coast (Blocks 22 to 30, Sub-blocks 31A, part of 31B):

Fishery-dependent data
The annual catch was 226t, approximately two thirds of the 1985-07 average, and apart from a small increase in 2006, has been at low levels for the past seven years. Reductions in catch were evident throughout most of the more productive sub-blocks in the region. Two exceptions were 22A, north of Cape Pillar and 24D on the north-east side of Maria Island, where recent year catches have been relatively stable or increasing. Catches from Block 31 increased from 4t to almost 10t, but this area is now producing catch at less than 20% of its former levels.

Regional catch rates fell for the second successive year, to 74kg/hr. All sub-blocks producing more than 10t in 2008 showed catch-rate declines except 24E. To put this decline in perspective, in some sub-blocks, catch rates were still relatively high, but have fallen from even higher levels. For example, catch rates around Maria Island (Block 24) remained above 80kg/hr, and around most of the Freycinet Peninsula (Block 27) and south of the Fortescue Bay (22A) above 70kg/hr. In the remainder however, catch rates have fallen to below 70kg/hr *i.e.* to much more moderate levels.

The CPUE distribution illustrates the change in catch rates between 2007 and 2008. The 2008 distribution is skewed more to the lower catch- rate categories, *i.e.* reductions in the high catch rate categories (100kg/hr and greater) with corresponding increases in all lower categories.

The size distributions have several feature of interest. Firstly, abalone in the south (Blocks 22, 23) tend to be larger, have a larger median size and 75th percentile length than those further north. Secondly, in many distributions the 25th percentile length is as small as or is smaller than the preceding year. Finally, the large increase in all percentile lengths in sub-block 23A, first seen in 2007, was repeated in 2008. In 2007 this increase was considered an artefact of sampling and disregarded. In 2008, a larger proportion, almost 20% of the catch, was sampled, confirming the earlier increase in size.

Diver perception
While divers considered that the fishing was still reasonable, most agreed that it had been a lot better, and that stock levels had fallen in recent years. Some moved from Bicheno and further north to other parts of the Eastern Zone because the East Coast catch rates were too low. In Munroe Bight (22A), south of Fortescue Bay, stocks that had provided good fishing in recent years have been reduced. Because the fish in this area tend to be larger, selective fishing is still practised by many divers, and thus may have reduced catch rates.

Weather conditions encouraged divers to move to Eaglehawk Neck or Fortescue Bay (Block 22) from Port Arthur and Nubeena, thus transferring effort from Storm Bay to the East Coast. Divers also moved to the Eaglehawk Neck from further north on the East Coast (Bicheno) at the request of processors, who found it more economical to pick up fish closer to their factories.

Some divers felt that the size limit was now too large for abalone populations at Hellfire Bluff, Point Leseur (Block 24) and Southerly Bottom (Block 23), but other divers believed that these populations were small in extent, and inconsequential to the rest of the East Coast fishery. The increase in legal minimum length and its effect on fishing Freycinet and further north was discussed. In parts of Block 27, a substantial proportion of fish could not be taken because they were too small. Opinion was divided about whether this was good because it meant that there were plenty of pre-recruits, or a problem because the size limit prevented taking these fish. (The reduction in the 25th percentile length suggests that there has been an increase in numbers of smaller fish from this area.)

The quantity and extent of *Centrostephanus* barrens between Wineglass and Schouten Island, and also at the Nuggets (Block 27) was reported to be increasing. Some of the productive reef deeper than 10m had been badly affected, and was now not worth fishing, although occasionally divers found that abalone were clustered near the edges of the barrens and that they could achieve high catch rates by fishing there. Divers said that they had to cover more coastline to land reasonable catches. Urchins were also reported to be destroying productive reefs off the beaches north of Seymour (Block 29), and in addition, small fish (pre-recruits) seemed to be very scarce on those reefs.

In the far north of the East Coast, effort in Block 31 was again low. The principal reason for the low catch was that processors would not accept the fish because they thought them to be of poor quality compared with fish from other parts of the East Coast. While parts of Block 31 hold large populations of low grade abalone, the offshore islands and Eddystone Point were reported to have fast growing, good quality abalone comparable with those from anywhere else on the East Coast. Growth analyses by TAFI on tagged abalone from George Rocks show that the have similar growth rates to those from Seymour Point (which is a preferred location for processors taking fish from the northern part of the East Coast). As reported in previous years, abalone were abundant in Block 31 in 2008.

Qualitative assessment
East Coast stocks continue to have areas of concern with decline in both catch rates and catch in some locations. In 2008 the catch was reduced below that in 2007, yet catch rates continued to decline. Stocks across the broader region do not appear to be rebuilding and appear at best stable. Stocks appear to be decreasing in the regularly fished and most productive parts of the fishery. Low grade abalone appear under-utilised in the far north.

Western Zone

North West (Sub-block 5D and Block 6):

Fishery-dependent data
In 2008, the minimum legal length for all parts of the region except sub-block 6D was reduced from 136mm to 132mm. In 6D it remained unchanged at 140mm. The size limit reduction immediately increased the size of the stock. Despite this, the regional catch was only 105t, a level similar to those of the previous five years. No catch was

taken from 5D, while 22t, 13t and 35t were taken from 6A, 6B and 6C respectively. 35t was also taken from 6D.

Catch rates increased by more than 30kg/hr in all areas where the size limit was adjusted, reaching 133kg/hr, 144kg/hr and 141kg/hr in 6A, 6b and 6C. In 6D where the size limit remained unchanged, catch rates also increased, by 15kg/hr to 139kg/hr. The CPUE distribution was transposed to the right by one category and became less skewed towards the lower categories (*i.e.* more normal), indicating that that the higher catch rates were common to all divers.

The change in catch sampling methods has meant that relatively high proportions of the catch were measured in 2008 (between 11% and 32%). Power of sampling has been greatest in block 6D, where all percentiles including the medians were remarkably smaller. This may have been due to size selection to match market preferences for smaller abalone, although the high catch rates and small 25th percentile indicate that there were increased levels of recruitment in the area.

Diver perceptions
It was expected that the reduced size limit would make the region more attractive to divers and processors, promoting a transfer of effort from the more heavily fished regions south of Strahan. However, this did not happen. Divers reported that the local processors preferred fish from other regions, or 6D, where the fish were reputed to be of better quality. Some southern processors accepted fish from the three northern sub-blocks, although remoteness and distance were disincentives.

It was the opinion of local divers that the improved catch rates in the region were not due solely to the size-limit increase, but that there has been increased recruitment throughout the region, particularly in 6D where there were increased proportions of small fish. The smaller size of fish in catch samples from 6D supports this belief. They maintained that stocks and pre-recruit numbers had been steadily increasing for several years prior to the size-limit increase. The ability of police to enforce the size-limit boundary was questioned, and some believed that the 140-mm area (6D) could be fished at 132mm with little risk of the infringement being discovered.

Qualitative assessment
The increased stock size caused by the size-limit decrease effectively makes catch-rates meaningless as a means to detect changes in abundance caused by fishing. Length data is consistent with divers' opinions that there has been increased recruitment in the region. High catch rates indicate that stock levels appear to be high.

Central West (Blocks 7 to 9):

Fishery-dependent data
The Central West region (not to be confused with the new Central West zone operating from 2009) produced an annual catch of 216t. Although previous years have not been much higher, the 2008 catch was the lowest since the implementation of zoning in 2000. Block 7 produced 51t, comprising 8t from north of the Pieman (7A), 27t from the Conical Rocks area (7B) and 17t from the remainder of the coast south to Granville Harbour (7C). Between 2000 and 2007, Block 7 produced an average of 70t pa, so the

2008 catch was substantially reduced from that level. Block 8 produced 9t, 5t of which came from 8A, and the remainder from 8B, and like Block 7, the Block 8 catch was greatly reduced (approximately 50%) compared with the post-zoning average. In Block 9, 6t came from the small strip of coast east of Cape Sorell (9A), 82t from 9B and 69t from 9C, for a total of 156t, almost exactly equal to the post-zoning average.

Regional catch rates increased slightly to 156kg/hr. Most of the increase can be attributed to Block 7, where catch rates approached very high levels (180kg/hr). In sub-block 8B, the small amount of catch (4t) was caught at a catch rate of over 200kg/hr. In 9B and 9C catch rates remained within levels typical of those of recent years (140kh/hr, 162kg/hr respectively). The CPUE distribution showed a transfer from lower catch rate categories (100kg/hr to 200kg/hr) to 200-250kg/hr.

The median size of fish was largest from 7A, 8A and 9C, at over 155mm. In 2008, median length, 25^{th} and 75^{th} percentile lengths were mostly smaller than in previous years among the higher yielding sub-blocks. Because of varying degrees of selective fishing in past years, and directives from processors not to fish in areas where larger abalone predominate, it is difficult to draw any conclusions about changes in median length.

Diver perception

Most of the catch from the region was taken from runabouts, not the motherships used in the South West. As in 2007, the level of catch from the Central West region was determined by the willingness of processors to collect fish from Strahan or Granville Harbour. Generally, fish unloaded at these ports received a lower beach price than those caught in the South West or South Coast and unloaded in the south east. According to processor returns from DPIW's licensing database, the average price for fish unloaded at Granville Harbour and Strahan was $30.76, compared with mothership product from the South Coast and South West at $35.56, and South Coast runabout catch at $37.50. This price difference was a strong determinant influencing where quota holders wanted their fish caught *i.e.* the Central West region was least preferred, and probably determined why the annual catch has fallen in recent years.

Stock levels north of Strahan (Blocks 7 and 8) were considered to be at satisfactory levels. The divers who fished there in 2008 had been fishing there for many years and were experienced at working in the area. The low catch in Block 8 was due to a paucity of suitable weather conditions (the area requires unusually low swell heights to be able to fish there), but when the sea was flat, they found abalone to be abundant as indicated by the high catch rates.

Divers who worked south of Strahan (Block 9) were less positive about stock levels. They remained surprised that stocks were able to take so much fishing pressure. Divers who regularly fished the area for many years said that they were able to maintain satisfactory catch rates by fishing only in ideal conditions. They were under no pressure to catch fish (because market demand for fish from the area was low), were able to use recent advances in weather forecasting and reporting to select only the best fishing days, and consequently could fish inshore populations which were usually inaccessible. Under these conditions, stable catch rates could be indicative of stock decline.

Although catch rates were higher north of Strahan, most divers chose to fish in the south because of the difficulty of working from Granville Harbour. The entrance to Stingray Bay, at best only 5m deep, was dangerous if swell heights increased unexpectedly and the beach and the access road made retrieving and towing heavily laden boats difficult. Corinna, an alternative launch site on the Pieman River, was so far inland that the state of sea conditions could not be determined until approaching the bar-way, by which stage divers were committed to working irrespective of swell height. They believed that the increased level of catch for the new Central West Zone TAC would require divers to work and be exposed to a greater level of risk when they would otherwise stay on shore.

Qualitative assessment
Levels of catch and catch rates indicated that stocks were stable or increasing north of Strahan (Blocks 7 and 8). South of Strahan (Block 9), catch rates and information from divers indicated that stocks were under pressure. Although catch rates remained at satisfactory levels, the circumstances under which divers say that fish were caught meant that catch rates did not necessarily reflect abundance (*i.e.* were hyperstable), and that stock levels could have declined.

South West (Blocks 10 to 11, Sub-block 12A):

Fishery-dependent data
Since zoning began in 2000, the regional catch has averaged approximately 600t, almost 150t greater than the 1985-2007 average. (This 1985-2007 average was calculated using catch totals from Blocks 10 and 11 plus 21% of Block 12 catch up to 2000, then catch from Blocks 10 and 11 plus 12A between 2000 and 2007). In 2008, the regional catch was 576t, almost 75t lower than the previous year's catch, and it appears that this was transferred to the South Coast.

Catch rates fell consistently across almost all sub-blocks. Regionally, they have fallen from 176kg/hr in 2000 to a new low of 114kg/hr in 2008. The CPUE distribution shows that divers were catching at rates of more than 200kg/hr much less frequently, and that the most common catch rate is between 100 and 150kg/hr.

We could not accurately detect changes to median size. Fishing is normally done from motherships which work across multiple blocks, making it impossible to identify from which sub-block catches were taken. The small amount of information available suggests that median length was stable at approximately 155mm in 10D and 11A.

Fisher perception
All divers believed that stock levels had continued to fall. Stocks were reported very low in the vicinity of Port Davey, including Rough Bay, Inner Saddle and Window Pane Bay. There were brief periods, particularly after protracted spells of bad weather when catch rates recovered, but they fell after sustained fishing.

Qualitative assessment
Indicators of stock abundance indicate a steady long-term decline in this region.

South Coast (Sub-blocks 12B, 12C, 12D, 13A, 13B):

Fishery-dependent data
The South Coast was closed to fishing from 29 October 2008 for the remainder of the year, with the regional catch reaching 332t. The 2008 cap was 245t. (The cap was calculated from the 1985-2006 average, after applying and removing the average proportion of catch from 12A between 2000 and 2006, to years between 1985 and 1999). The 2008 catch was the largest annual catch since 1985, when catch dockets were first introduced. With the exception of 13B, the catch increase was distributed across all sub-blocks, the largest volume coming from 12D (119t).

Since 2001, regional catch rates have averaged 97kg/hr, fluctuating within a 10kg/hr range. They have been slightly lower in the past five years, and in 2008, were 95kg/hr. At the sub-block level, catch rates were below 100kg/hr in all except 12C (Maatsuyker Group – 110kg/hr), and below 90kg/hr for the first time in 12B (westernmost sub-block). The modal catch-rate category of the CPUE distribution was lower at 75-100kg/hr, and more than 20% of catches were taken at between 50 and 75kg/hr.

The median size has trended downwards since 2000 in all sub-blocks where sufficient levels of sampling have been undertaken (12C, 13A and 13B). Median size was still comparatively large in the more remote sub-blocks, but tended to become smaller moving eastward, and in 13B was below 150mm.

Fisher perception
Some divers felt that South Coast stocks could be fished at low catch rates but would recover – unlike South West stocks which would remain suppressed for much longer. They said that this was because the South Coast habitat was more complex (more boulders, less slabs and flat surfaces) than in the South West, giving abalone more chance to hide and evade capture.

Nearly all divers stated that stock levels were under pressure, and unless they were familiar with the region and knew where to avoid recent fishing, found it difficult to achieve satisfactory catch rates. They agreed that catch and catch-rate trends indicated that stock levels were at best stable, and probably falling.

They noted that the increase in catch was predominantly market driven. The South Coast fish were in demand by processors for live-market product. Weather, particularly from the north-west, frequently prevented divers from working west of South West Cape, forcing effort onto the South Coast. Some parts of the South Coast could be fished when swell height prevented fishing further west, and rising fuel prices also drove effort into this region.

Qualitative assessment
Catch rates, while appearing stable were at a relatively low level and combined with the reduced size of abalone in catch samples, indicate that exploitation rates remained high. Stock levels were at best stable, and probably falling.

Northern Zone

King Island (Blocks 1 to 4):

Fishery-dependent data
The regional catch has fallen sharply to 39t from a high of almost 130t in both 2004 and 2005. Most of the blacklip catch (24t) was taken from Block 3. Since 2007, this reduced level of catch has largely been a consequence of management measures to reduce the risk of spreading AVG, by preventing the transfer of abalone by sea from King Island to the Tasmanian mainland. Only three divers fished King Island waters in 2008.

Catch rates have continued to increase in recent years, and in 2008 averaged over 120kg/hr. The CPUE distribution shows a substantial reduction among low catch rate categories, with a pronounced mode at 125-150kg/hr.

There is no information about changes in median length (no catch sampling was done on the island).

Fisher perception
Approximately two thirds of the catch was taken by a diver using Nitrox breathing apparatus, enabling him to work deep-water stocks for longer bottom times with a higher degree of safety. Stocks were extensive, and the most limiting factor affecting catch rates was the requirement to measure abalone because of their small size. If the size limit was reduced, catch rates would be greatly improved. Because of the reduction in catch, shallow water stocks were recovering from heavy fishing pressure in earlier years, and catch rates have improved there. Apart from quarantine measures, weak market demand has limited the amount of catch taken from King Island.

Qualitative assessment
There were no indications that levels of fishing were unsustainable. Stock levels in shallow water appear to be high and rebuilding with opportunity for increased catch.

North West (Blocks 47 to 49, Sub-blocks 5A, 5B, 5C):

Fishery-dependent data
There were significant management changes in this region that have affected the performance of this part of the fishery. The size limit in Block 5 was reduced from 132mm to 127mm (for divers operating under special permit *i.e.* most divers). The Block 5 cap was increased from 100t to 152.5t, and the remainder of the Northern Zone was capped at 180t to ensure that the increased level of catch was taken from Block 5.

The regional catch was 247t, an increase of 90t over the previous year. The Block 5 catch was 163t. Of this, 70t was taken from 5A, 35t from 5B and the remainder from 5C. Catch levels were doubled in 5A and 5B over previous years, but effectively remained unchanged in 5C. Block 49 contributed a further 74t, of which almost half was taken in 49C, adjacent to 5A. Catches from Albatross Island (49B) have been falling steadily. In recent years, the annual catch from 49B has ranged between 30 and 40 tonnes, but in 2008 it fell to 24t. The remainder of the Block 49 catch (33t) came

from Three Hummock Island (49A). Seven tonnes was taken from Block 48, and no catch was recorded from Block 47.

Block 5 catch rates increased sharply in response to the reduction in size limit and effective increase in stock size. At the remote 49B, catch rates have declined by nearly 60kg/hr since 2004, and were approaching 100kg/hr. At 49A and 49C, catch rates were stable at 89kg/hr, and 85kg/hr respectively.

The size of fish from sub-blocks 5A, 5B and 5C was greatly reduced between 2002 and 2008, with the median size falling by 10mm in 5A, and 8mm and 7mm in the other two sub-blocks. In both 2002 and 2008, 7% or more of the catches were sampled *i.e.* sampling was probably at sufficiently high levels to detect changes in size of fish in the stock, and not just reflect growth differences between places where divers fished.

Fisher perception

Many divers have been impressed with the catches in Block 5 following the size limit reduction. In some bays, they said that the size limit could be reduced further, because they were leaving many undersized fish that they considered were mature. They worked bays that they had never considered working before (because prior to the size-limit reduction the fish were too small), and although catch rates were high, were poor indicators of abundance because they spent more time measuring and handling fish than they had on the more exposed coast where the fish were bigger. On the other hand, other divers were concerned that the prime fishing reefs that yielded higher quality fish were being denuded of abalone, and would take years to recover.

In 5A, most of the increased catch (70t) was taken from a small area near Trefoil Island, which divers likened to the Actaeons because it had been so productive. Most of the coast south of the Doughboys was not worth fishing because catches were so poor. 5C was fished by a greater proportion of non-resident divers than the other sub-blocks and catch rates varied greatly between divers. It was reported that some were unfamiliar with the area, having been asked to go there by processors or quota holders to take advantage of the increased TAC. Their lack of knowledge prompted them to work places shunned by those with more experience and consequently unfished for many years. Although catches were variable, they regularly found large quantities of abalone and landed good catches.

Elsewhere in the region and unaffected by the size-limit change, Albatross Island stocks in 49B have dwindled following regular fishing since 2004. Catches there were not much better than those from the more accessible areas closer to Woolnorth. Fishing has improved at Three Hummock Island (49A), but deteriorated at the Petrels (48B). No fishing was done in Block 47 because the size limit was believed to be too large to make catching abalone economically viable.

Qualitative assessment

Because of the size limit change in Block 5 and consequent increase in stock size, it is not possible to draw reliable conclusions about the increase in catch rates in 2008 other than to state that there were more fish available. In the remainder of the region, stock levels appeared stable. There may be an opportunity for increased catch if the size limit was reduced in Block 47, but the extent of the increase is likely to be small.

North East (Northern part of 31B, Blocks 39 and 40), **Furneaux Group** (Blocks 32 to 36, 38A):

Fishery-dependent data
The North East catch (34t) returned to more normal levels following the sharp increase to 66t in 2007. In 2008, most of the catch was again taken from around Swan Island in 31B (29t). In the Furneaux Group, 12t was landed, divided almost equally between the south-east of Cape Barren Island (Block 33) and Babel Island (sub-block 38A).

Catch rates in the North East fell from 75kg/hr to 58kg/hr. In 31B, they fell by 20kg/hr to 58kg/hr, a substantial decline. Catch rates in the Furneaux Group, particularly Block 33, have been variable in recent years, and almost certainly reflect the ability of visiting divers to find isolated pockets of abalone rather than variation in abundance. However at Babel Island, the small amount of fishable reef in conjunction with the relatively high catch may improve the ability of catch rates to reflect abundance. Catch rates there declined marginally from 68kg/hr in 2006 (year of last big catch) to 64kg/hr in 2008.

No measurements of abalone were obtained from catch sampling.

Fisher perception
Divers reported that fishing was much poorer at Swan Island than in the previous year. Given the high level of catch in 2007, they expected that it would not fish as well. Some divers left the region and fished in the North West in 2008.

On the south-east shore of Cape Barren Island, divers were frustrated by the quantity of undersized fish, and said that the fishing could be improved if the size limit was reduced to 114mm, the same size as that operating in the north of the Furneaux Group. Fishing was better at Babel Island, but here again they thought that a smaller size limit would improve fishing.

Qualitative assessment
It is apparent that stocks have been substantially reduced in the North East, particularly around Swan Island, and that annual catches of the magnitude of the 2007 catch are not sustainable, and affect fishing in future years. There is insufficient information to determine whether stocks were stable but at a reduced level, or whether they continued to fall. In the Furneaux Group, in the absence of information to the contrary, blacklip stocks were assumed to be stable.

Bass Strait Zone

Fishing in the Bass Strait blacklip fishery resumed in 2008, after being closed as a precautionary measure to prevent the spread of AVG from Victorian waters to the Tasmanian fishery. The remote island region, including the Kent, Hogan and Curtis Groups, was closed for almost two years. The remainder was closed for 2007 only.

Of the 70t TAC, almost half (34t) was caught in the remote island region (Blocks 50-56), and of this, 27t was taken from the Hogan Group. In the Furneaux Group, 21t was caught from Block 37, almost all of which (18t) came from the Sisters or northern tip of Flinders Island (37D). A further 13t was taken from the central part of the Tasmanian north coast from Blocks 41 to 46.

Catch rates improved substantially in the remote islands, to 74kg/hr, and in the Furneaux Group, to 54kg/hr. They remained low but stable on the central north coast, at 41kg/hr.

Fisher perception
Divers were surprised by the amount of fish available at the Sisters (37D), and despite the high fishing pressure focussed on such a small area of reef, found that they could make repeated trips there without any apparent reduction in catch rates. Fishing in other parts of the Furneaux region was less successful, and although some catch (2.5t) was taken from 37C, there was little interest in fishing elsewhere because they could not find sufficient quantities of fish.

At the Hogan Group, fishing was reported to be as good as it had ever been. Very little (less than 1t) was taken from the Kent Group, and catch rates there were reported to be disappointingly low. The Moncoeur and Rodondo Islands were not fished, but Curtis Island produced 6t at good catch rates.

The central part of the north coast required much more effort to catch fish, and although abalone populations were occasionally extensive, they were often too small to be fished at the 110mm size limit. This part of the fishery is mostly supported by larger growing populations at places such as the mouth of the Tamar and the coast between Rocky Cape and Wynyard, and which once fished, recover too slowly to support repeated fishing.

Qualitative assessment
The 2007 closure enabled stocks in all regions to recover, and halted a decline in catch rates. Stock levels now appear to be stable in the remote islands and the Furneaux Group. There is less confidence with the north coast stocks, and means of spreading catch across some of the smaller growing stocks could be investigated.

Greenlip fishery

Fishery derived performance measures such as changes in catch rates and catch are difficult to interpret for the greenlip fishery for the following reasons:

- The greenlip TAC is relatively small (122.5t), and each region's catch is capped, effectively masking changes in catch that might indicate changed stock levels.
- Good catches are dependent on knowledge of the regions' stocks and consequently averages of catch rates are influenced by the contribution of effort of individuals. Most of the greenlip catch is taken by a few individuals living in the north of the state and offshore islands.
- In the North West and North East, divers usually catch both greenlip and blacklip in a single fishing trip. When reporting catches, some divers estimate the proportion of time taken to catch each species, while others report the total amount of fishing time twice, once for each species. Reliability of the first method depends upon the divers ability to accurately gauge how much time was devoted to catching each species. The second method is likely to be more accurate, but catch rates will be lower (for both species). The effect of the

second method is noticeable in CPUE distributions from these regions where up to 20% of catches were reported with catch rates of less than 25kg/hr.

- Markets often preferred large greenlip to smaller greenlip. A diver selecting only large greenlip will usually catch fish at lower catch rates than a diver who takes fish of all legal sizes.

The King Island catch was 20t. The King Island catch has been capped at 30t, but has been under-caught for several years. Recent restrictions that prevent the transfer of abalone by sea from King Island to the Tasmanian mainland effectively stop visiting divers working from motherships there, and this has reduced effort for both species in the region.

Resident divers reported that stocks were stable, although of limited abundance. For several years, they have said that the 30t cap was too high for the island, and that lower catches were required to enable stocks to rebuild. There is no evidence that stock levels were increasing, despite the reduced catches.

In the North West, 41t was landed, 22t of which came from the reduced size-limit area at Black Reef in Perkins Bay (48A and Block 47). Catch rates from 48A were high (110kg/hr), and in conjunction with divers' reports, do not indicate that stocks were being depleted. Most comments about this part of the fishery were favourable, and it was said that the quality of the fish had improved following the increased fishing pressure. Several divers were concerned that the size limit had been reduced too far, and were sceptical that recruitment could be maintained.

Egg-per-recruit studies conducted by TAFI (Tarbath, 2006) in 2005 indicated that Perkins Bay should be able to support a 20t catch at a 132mm minimum legal length provided that effort was distributed evenly between populations (*i.e.* fish were taken from Block 47 in addition to 48A) and that abalone did not grow at faster rates as a consequence of the increased fishing mortality. No catch has been reported from Block 47 since the size limit reduction, and it is likely that the intensive effort focussed on Black Reef will be detrimental to future fishing.

In other parts of the North West, fishing pressure has been reduced through transfer of effort to Perkins Bay, and stock levels were said by divers to be low but stable. The low catch rates from Block 49 were due to most of the catch being caught by one diver, who fished for both greenlip and blacklip, and reported the total fishing time for each species. Individual catch rates from others who fished only for greenlip were much higher.

In the North East (Blocks 39, 40 and sub-block 31B), 24t was landed. This was a large reduction from the previous year's catch, when more than 33t was landed because of management difficulties in implementing the cap. In both years, in 31B (which includes Swan Island), the majority of divers fished for both species on a single trip, but some divers split effort between species, while others reported effort twice, and consequently average catch rates were not useful indicators of changes in abundance. At Swan Island, divers said that greenlip stocks had been adversely affected by the high catch levels from the previous year. In Block 39, divers landed mostly greenlip. Catch rates were 61kg/hr, and divers said that stock levels were satisfactory.

In the Furneaux Group, approximately two thirds of the annual catch (35t) was landed by one diver who has consistently fished in the same manner (*i.e.* selectively fished for

high grade fish) for many years. His catch rates have been relatively stable during this period, although he said that he has found it increasingly difficult to maintain fish quality because there were insufficient fish growing to a large enough size. He said that smaller legal-sized fish were relatively abundant.

Qualitative assessment
Greenlip stocks appear to be stable across the wider fishery. The management action to reduce the size limit and increase the catch at Perkins Bay appears to have been successful, and while the size-range of fish there did not suit all markets, it reduced pressure on other parts of the fishery where fish were less abundant. While there were no indications of serious declines, maintaining the distribution of catches at approximately the current levels is expected to result in rebuilding in those areas where levels have been reduced.

Recreational fishery

Recreational abalone fishing licenses are issued annually, expiring on 31st October each year. New licenses are available from 1st November. Most licenses are issued prior to Christmas, coinciding either with the opening of the rock lobster season in November or with the holiday period over Christmas.

The number of recreational abalone licenses has increased by an average of ~10% annually since the 1995-96 season (Figure 4), and in the 2007/08 season, 13,538 recreational abalone diving licenses were issued. The most recent survey of recreational divers was undertaken for the 2006/2007 season (Lyle, 2008). Its results showed that 105,500 abalone were taken. Assuming that the recreational catch had a length-frequency distribution similar to that of the commercial fishery, it was estimated that the recreational catch was 49t, which was less than 2% of the 2008 commercial catch. Approximately 40% of the recreational catch was taken in the south-east.

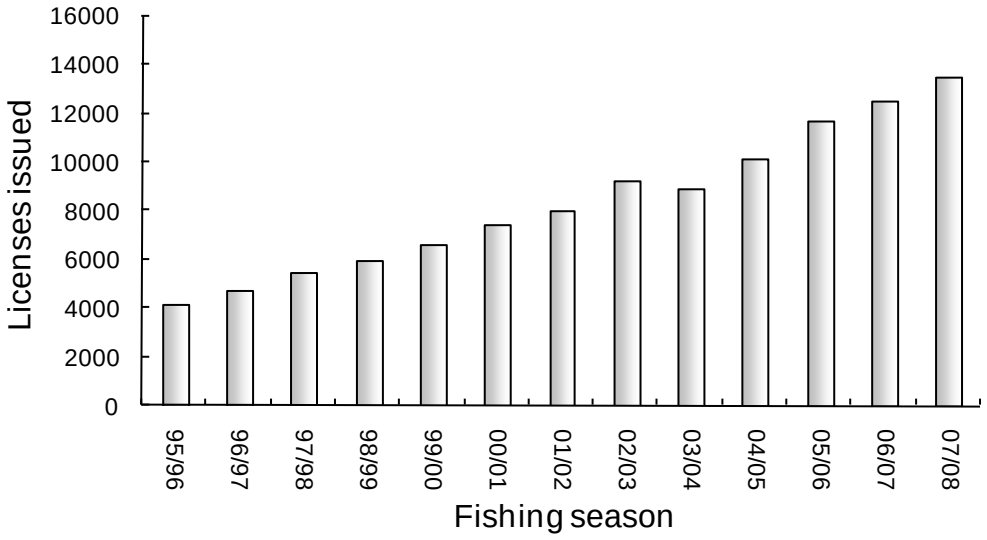


Figure 4. The number of recreational abalone diving licenses issued for the fishing seasons 1995-2008.

Indigenous, illegal and permit fisheries

Abalone were caught in Tasmanian waters as part of cultural fishing activities by indigenous people, under permits for special events and research purposes, and as part of illegal fishing operations. There were no estimates available for either the illegal catch or for the total catch from cultural fishing activities. The quantity of abalone taken under permits for special events and research purposes was less than one tonne.

Assessment Summary

Eastern Zone
Actaeons: Stock levels were stable or possibly increasing, but unlikely to be decreasing.
Bruny Island: Stock size has reduced from former levels. No indications that stocks were increasing. Stock levels were either stable or decreasing.
Storm Bay: Stock levels appear stable, unlikely to be increasing or decreasing.
East Coast: Stock size has been reduced from former levels. No indications that stocks were increasing. Stock levels were possibly stable but more likely to be decreasing.

Western Zone
North West: Size limit change prevents more accurate assessment, but stock levels appear to be high and experiencing increased recruitment.
Central West: North of Strahan, stock levels were stable or possibly increasing. South of Strahan, stocks have been reduced and while possibly at stable levels, were more likely to be falling.
South West: Stocks have been in sustained decline. There were no indications that stock levels have stabilised.
South Coast: Stocks have been reduced to relatively low levels and appear to be in continuing decline.
Model projections of stock levels for Blocks 9-13 suggest that there is a greater than 50% probability of decline with the current levels of catch and that for catch rate increases to occur, the catch would need to be reduced to below 900t (Haddon, 2009).

Northern Zone
North West: Size limit change prevented more accurate assessment, but stock levels seemed to be high.
King Island: The level of catch was low. There were no indications that levels of fishing were unsustainable. Stock levels in shallow water appear to be increasing.
North East, Furneaux Group: There is insufficient information to determine whether North East stocks were stable but at a reduced level, or whether they continued to fall. Stocks in the Furneaux Group appeared stable although with limited data.

Bass Strait Zone:
Stock levels appear to be increasing or stable in the remote Bass Strait islands and the Furneaux Group. There is less confidence with the North Coast stocks, where divers report that stocks failed to recover, or recovered very slowly, following fishing.

Greenlip:
Greenlip stocks appear to be stable throughout the fishery. Stock levels were reported low on King Island, in the North West except Perkins Bay and the North East. In the

Furneaux Group, stocks continued to rebuild from the low levels of the 1990's. At Perkins Bay, stock levels were high.

Management recommendations

Eastern Zone: From 2008, an annual 5% increase in TAC for the Eastern Zone was implemented conditional on ongoing improvement in performance of the Eastern Zone fishery. While there are regions within the Eastern Zone that appeared to be stable (e.g. Actaeons and Storm Bay), other areas appeared less resilient to higher levels of catch (e.g. Bruny Island, East Coast). Managing the spatial distribution of catch appears critical if the 5% increase in Eastern Zone TAC for 2010 is to be implemented. Stock levels in Block 31 appeared high with low exploitation rates due to market pressures from processors. Development of options to increase harvests in this block would assist in reducing catch in other areas of the zone.

Western Zone: For the 2009 fishing year, the TAC from the new Western Zone (Blocks 9-13) was reduced to 924t. Model projections for Blocks 9-13 suggest that there is a greater than 50% probability of decline with this TAC and that for catch-rate increases to occur, the TAC would need to be reduced to below 900t. Distribution of catch within the Western Zone was uneven, with catch in Block 6 remaining low (i.e. stock levels relatively high) despite the reduced size limit, because catch was taken from further south due to market pressures.

Northern Zone: The King Island blacklip catch has dropped substantially, and while this has increased stock levels in the region, it likely that greater levels of catch could be sustained. The major impediments to increased catch were the quarantine movement restrictions, difficulties and costs associated with operating from the island, and weak demand for its product. It is recommended that this part of the fishery be reviewed, and options developed to increase the contribution of this region to the Northern Zone catch, and to reduce catch in the North East.

Greenlip fishery: Use of fishery data to monitor stock levels in both the Northern Zone and Greenlip fishery is compromised by the way that divers report effort when fishing for both species in a single trip. It is recommended that a standard method of reporting effort be developed so that changes in catch rates would become more useful indicators of abundance.

In general: The challenge in management of the Tasmanian abalone stocks remains the management of the spatial distribution of catch. It appears that catches in some blocks (e.g. 6 and 31) could be increased but these areas are being avoided by divers due to poor market traits. This comes at the cost of lost opportunity plus greater potential for excess catch in other areas. Attempts to manage spatial distribution of catch in the Western Zone have only been partially successful and further exploration of spatial management tools is suggested.

3. Catch, catch-rates and size-composition

Eastern Zone blacklip fishery

Distribution of catch

Between 2004 and 2007, the Eastern Zone TAC was 770t. In 2008, the TAC was increased by 5% (to 808.5t). Figure 5 compares levels of catch between regions in the Eastern Zone during the period when the TAC has been maintained at 770t.

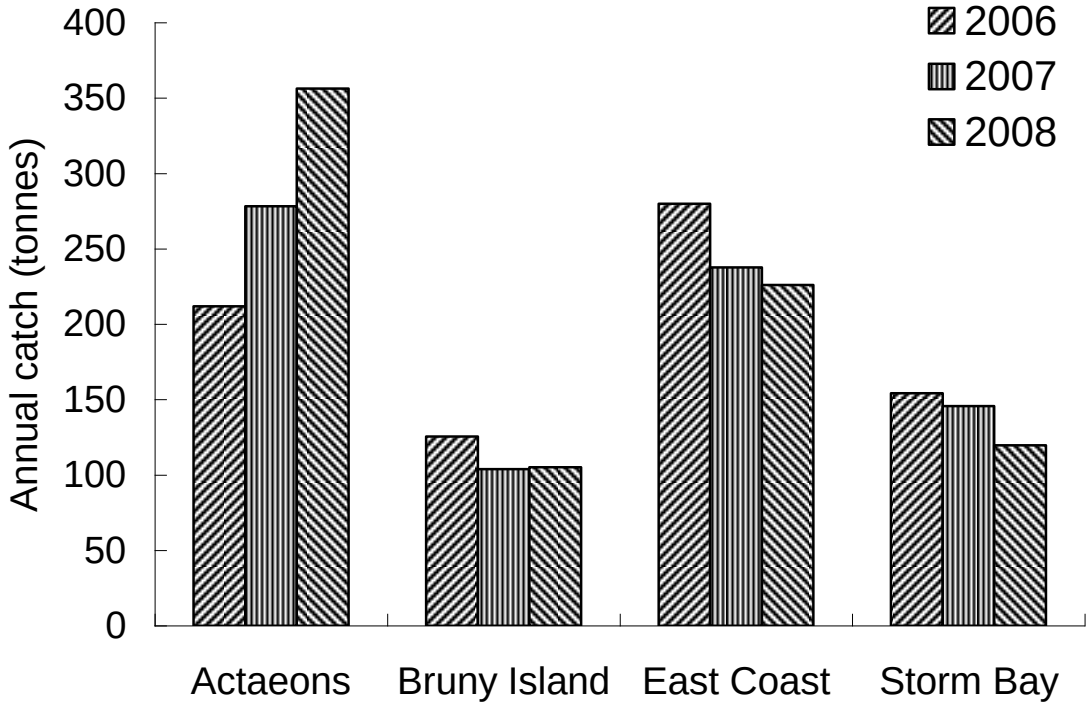


Figure 5. Distribution of catch, by region, Eastern Zone 2006-2008. Between 2006 and 2007, the TAC was 770t. This was increased to 808.5t in 2008. For an explanation of the reporting blocks covered by each region, see the Introduction (page 1).

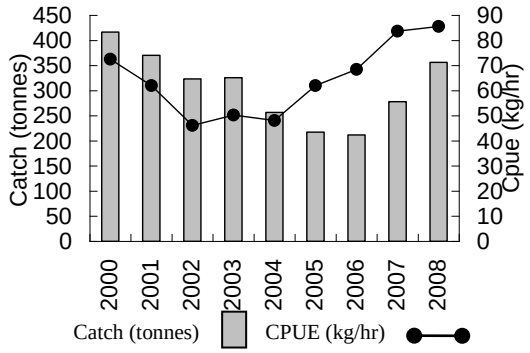
There has been a substantial increase in catch at the Actaeons, from an estimated 212t in 2006 to 356t in 2008 (Figure 5). The catch was high relative to catches of previous years, although is lower than the levels experienced during the late 1990's and early part of this century when estimated catches were over 400t. The average catch for this region was 283t (calculated using 80% of Block 13 catches and 30% of Block 14 catches between 1985 and 1999, then 13C to 14B catches between 2000 and 2007).

The Bruny Island catch was low relative to historical catch levels. The 2008 catch, almost unchanged from the previous year, was 105t, compared with the 1985-2007 average of 186t (calculated using 70% of Block 14 catch up to 2000, plus catch from Blocks 15 and 16, then catch from 14C, 14D and 14E, plus Blocks 15 and 16 between 2000 and 2007).

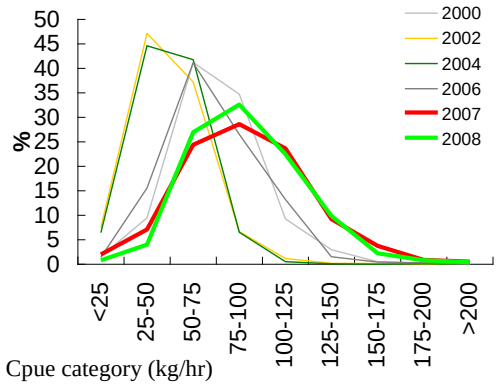
On both the East Coast and in Storm Bay, catches fell. The East Coast catch at 226t was among the lowest recorded, and is well below the 361t (1985-2007) average, while the Storm Bay catch (120t) was also below average (170t).

Actaeons, Lower Channel (Sub-blocks 13C, 13D, 13E, 14A, 14B)
Catch and catch rates

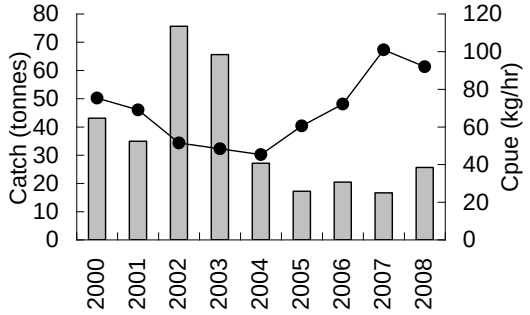
Regional view:



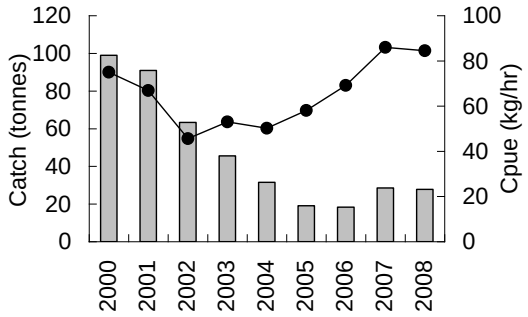
CPUE distribution:



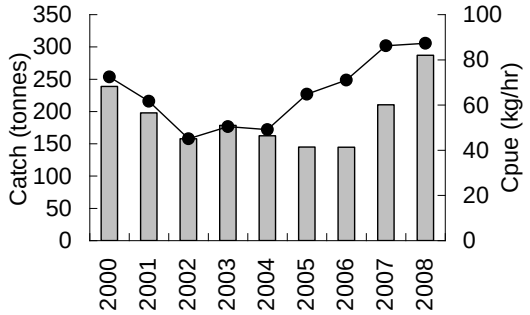
Sub-block 13C
Fishers Point to Whale Head



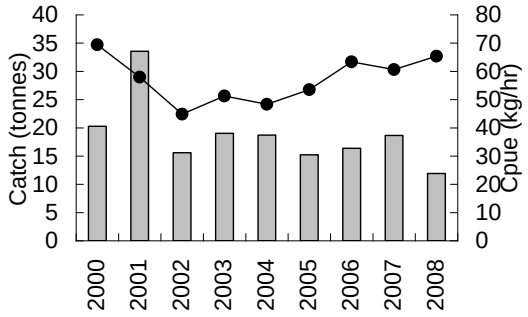
Sub-block 13D
Fishers Point to Southport Lagoon Beach, including Recherche Bay



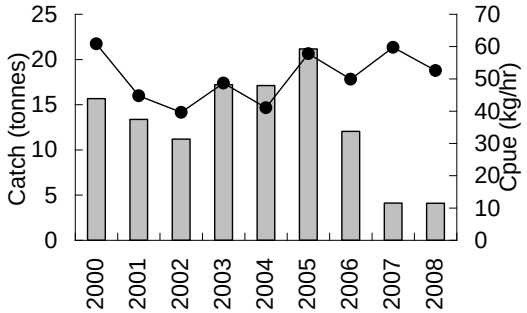
Sub-block 13E
Actaeon and Sterile Islands, and reefs to the south (the Breaks)



Sub-block 14A
Southport Lagoon Beach to Burnett Point

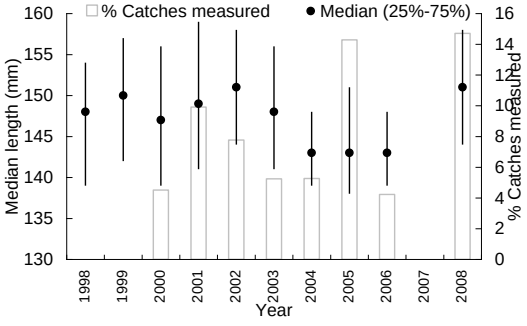


Sub-block 14B
Burnett Point to Blubber Head

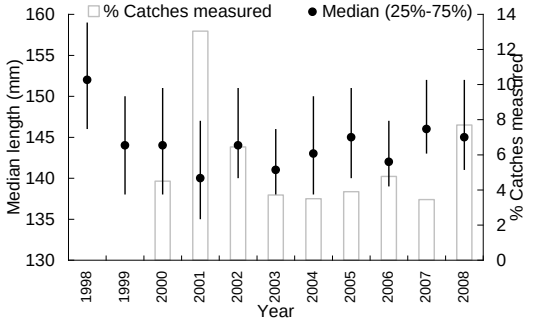


Actaeons, Lower Channel (Sub-blocks 13C, 13D, 13E, 14A, 14B)
Median length of catch

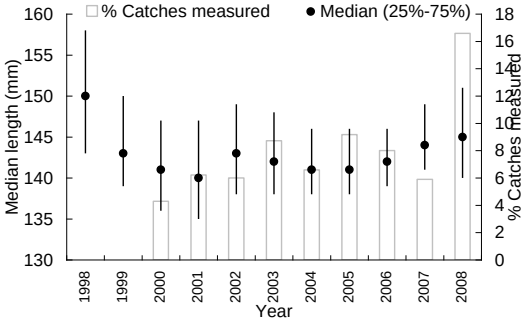
Sub-block 13C
Whale Head to Fishers Point



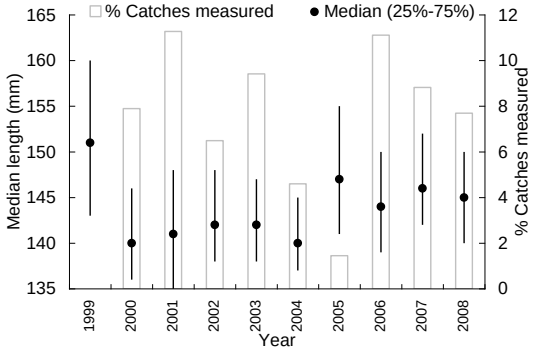
Sub-block 13D
Fishers Point to Southport Lagoon Beach, including Recherche Bay



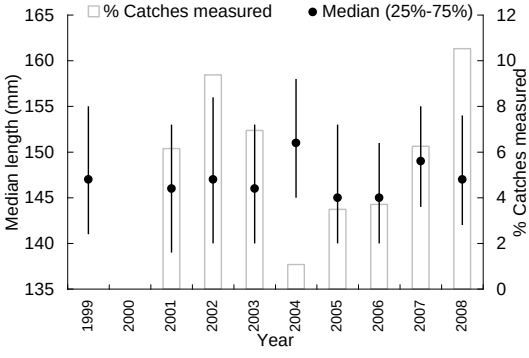
Sub-block 13E
Actaeon, Sterile Islands, associated reefs



Sub-block 14A
Southport Lagoon Beach to Burnett Point

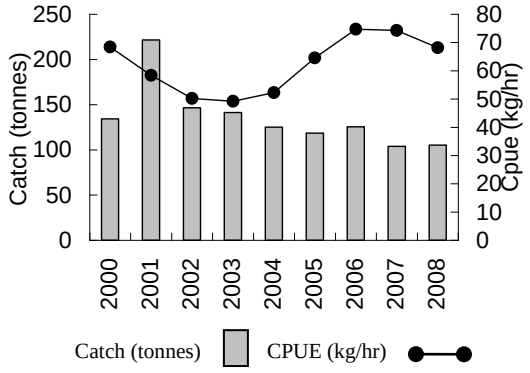


Sub-block 14B
Burnett Point to Blubber Head

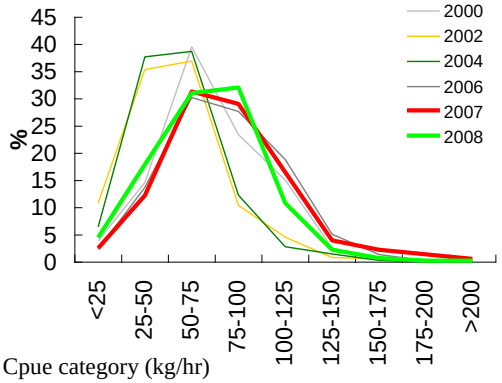


Eastern Zone – Bruny Island (Blocks 14C, 14D, 14E, 15, 16).

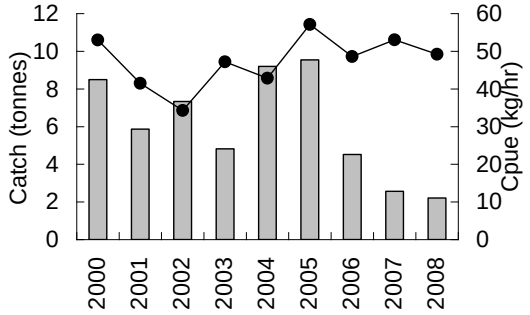
Regional view:



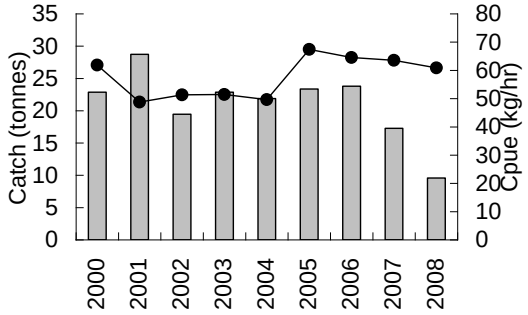
CPUE distribution:



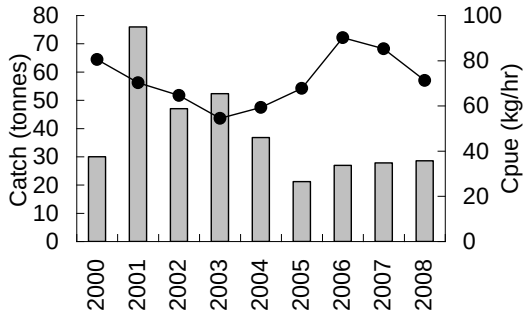
Sub-block 14C
Mays Creek to Hopwood Light (Lower Channel)



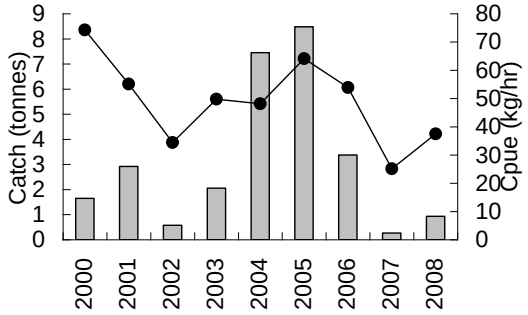
Sub-block 14D
Hopwood Point to West Cloudy Head



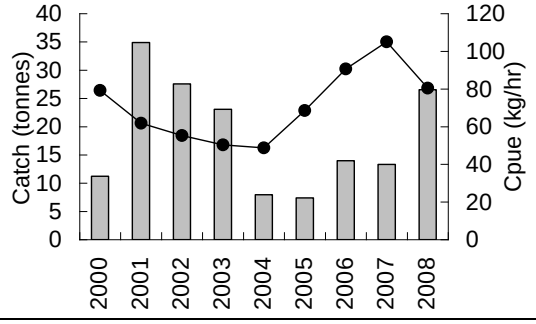
Sub-block 14E
West Cloudy Head to Boreel Head, including the Friars



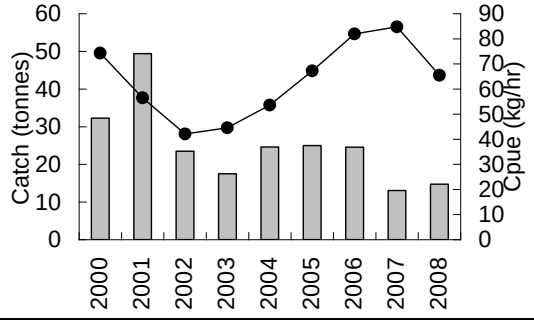
Block 15
D'Entrecasteaux Channel, Huon Estuary



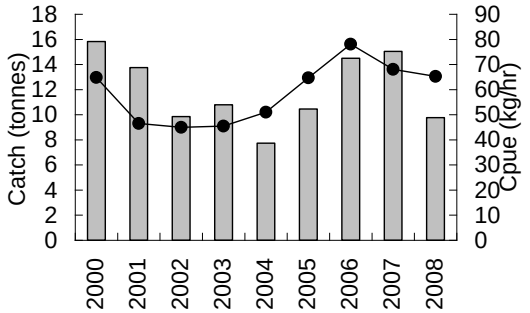
Sub-block 16A
Boreel Head to North Mangana Bluff



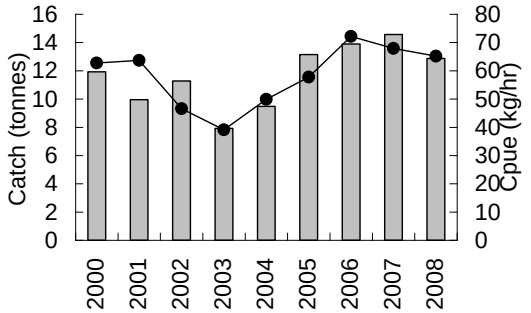
Sub-block 16B
North Mangana Bluff to Neck Beach



Sub-block 16C
Neck Beach to Trumpeter Bay

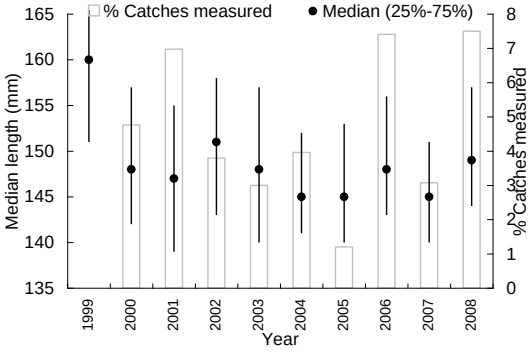


Sub-block 16D
Trumpeter Bay to Dennes Point

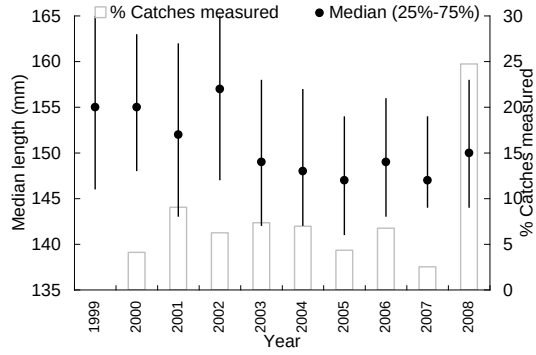


Eastern Zone – Bruny Island (Blocks 14C, 14D, 14E, 15, 16).
Median length of catch

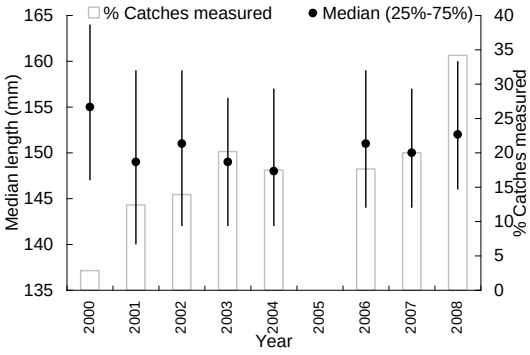
Sub-block 14D
Hopwood Point to West Cloudy Head



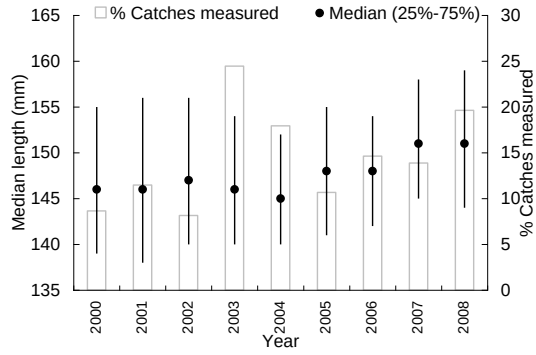
Sub-block 14E
West Cloudy Head to Boreel Head, including the Friars



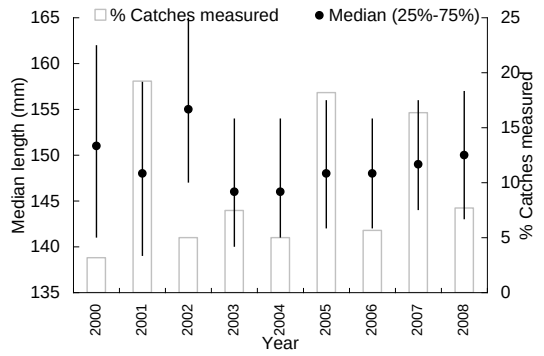
Sub-block 16A
Boreel Head to North Mangana Bluff



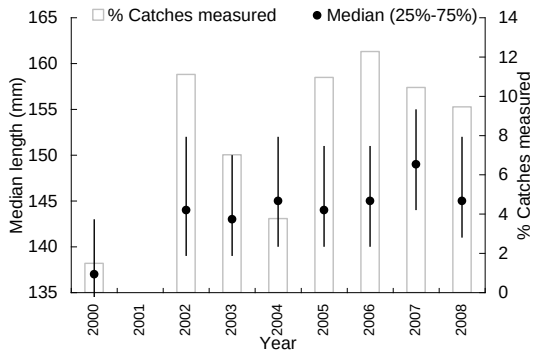
Sub-block 16B
North Mangana Bluff to Neck Beach



Sub-block 16C
Neck Beach to Trumpeter Bay

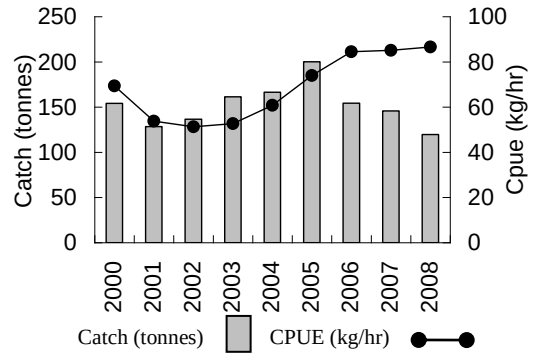


Sub-block 16D
Trumpeter Bay to Dennes Point

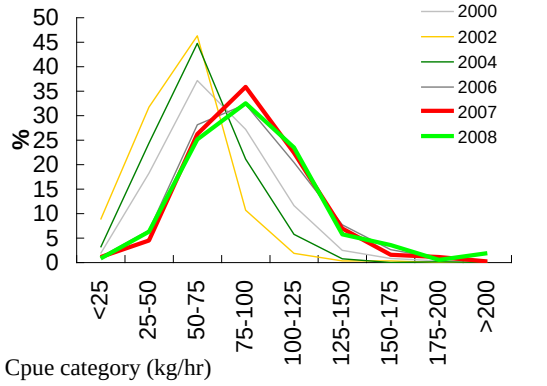


Eastern Zone - Storm Bay (Blocks 17-21)

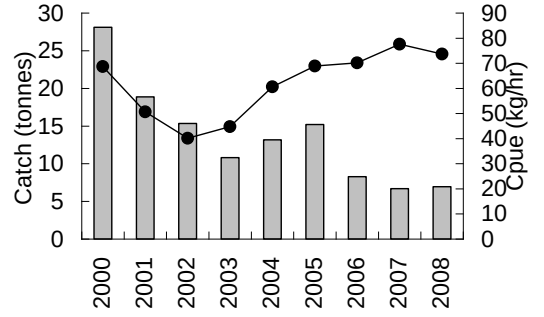
Regional view:



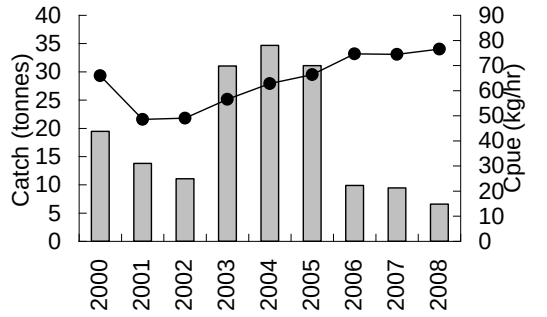
CPUE distribution:



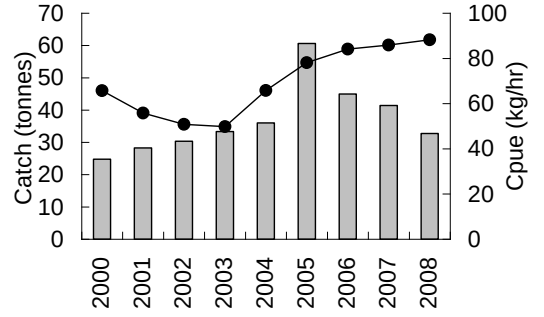
Sub-block 17B
Blackjack shoreline from Lobster Point to Outer North Head



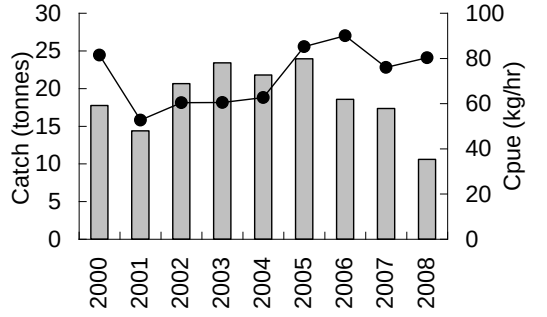
Sub-block 20A
Outer North Head to White Beach



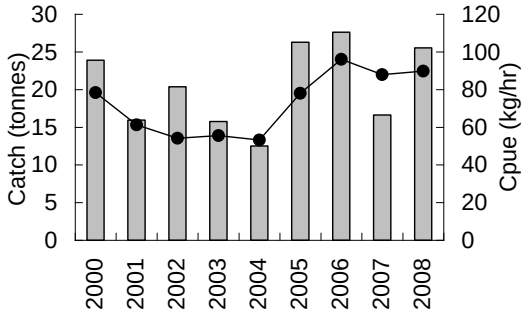
Sub-block 20B
White Beach to Salters Point



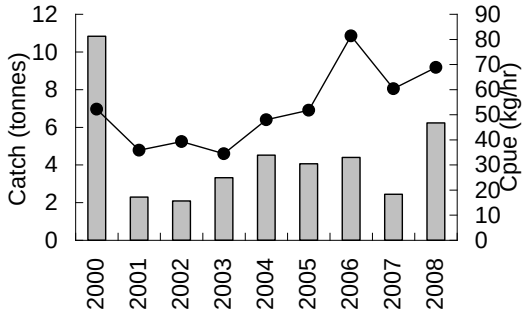
Sub-block 20C
Salters Point to Cape Raoul



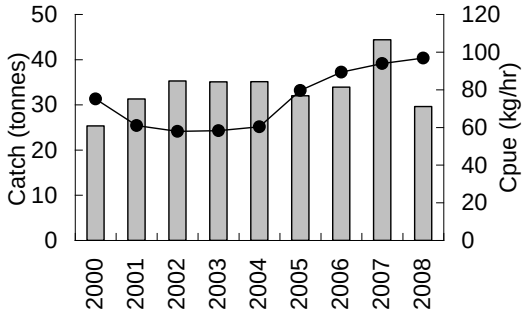
Sub-block 21A
Cape Raoul to Port Arthur



Sub-block 21B
Port Arthur

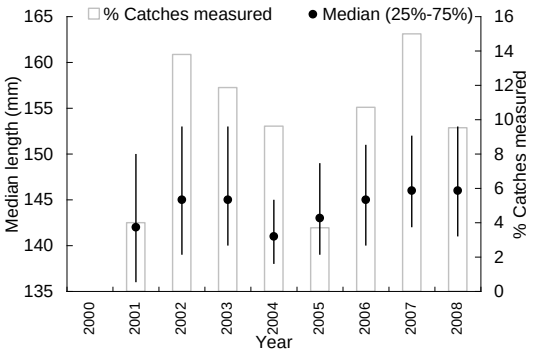


Sub-block 21C
Port Arthur to Cape Pillar

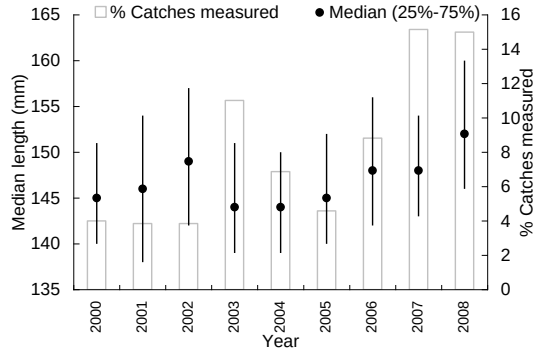


Eastern Zone - Storm Bay (Blocks 17-21)
Median length of catch

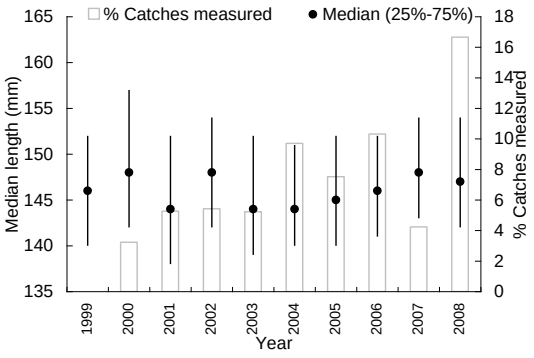
Sub-block 17B
Blackjack shoreline from Lobster Point to Outer North Head



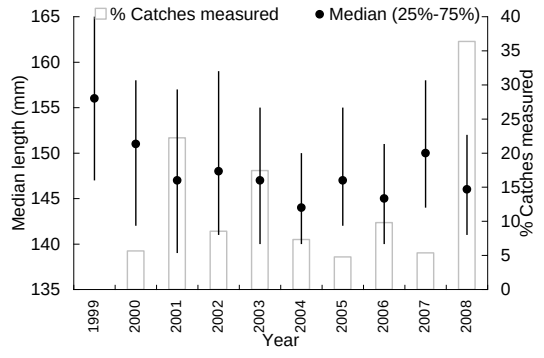
Sub-block 20A
Outer North Head to White Beach



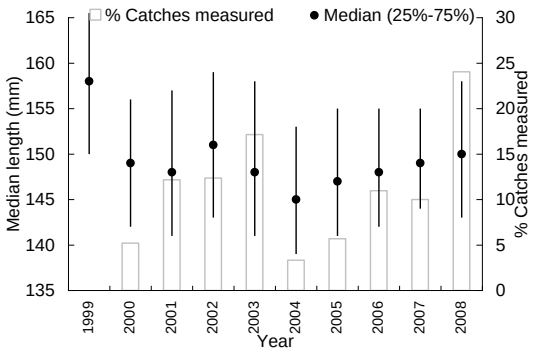
Sub-block 20B
White Beach to Salters Point



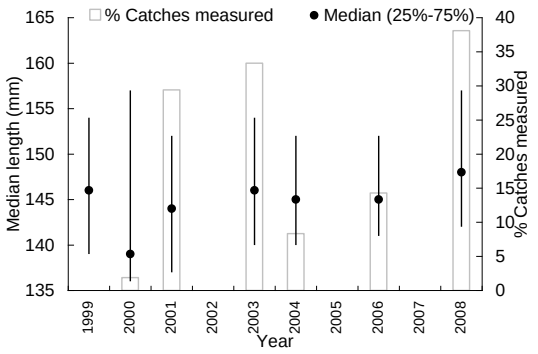
Sub-block 20C
Salters Point to Cape Raoul



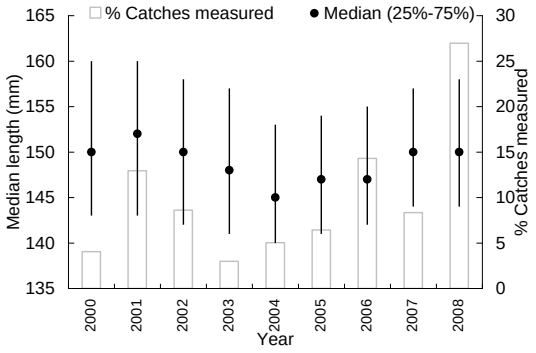
Sub-block 21A
Cape Raoul to Port Arthur



Sub-block 21B
Port Arthur

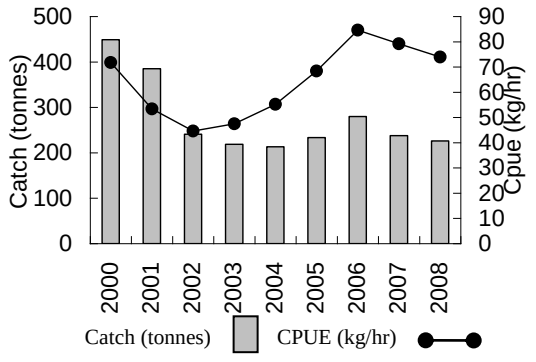


Sub-block 21C
Port Arthur to Cape Pillar

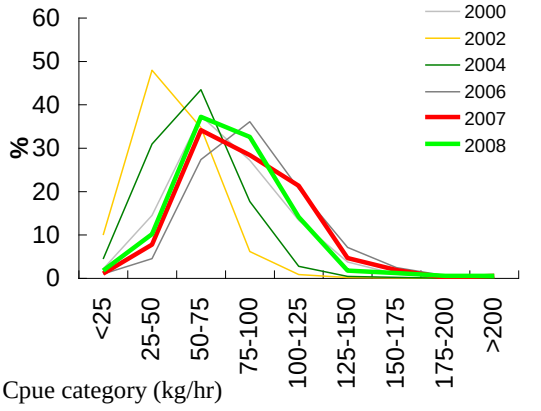


Eastern Zone – East Coast (Blocks 22-31)

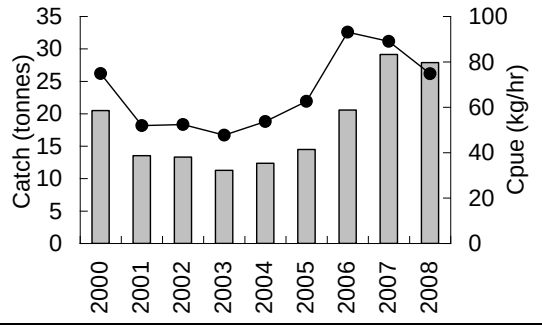
Regional view:



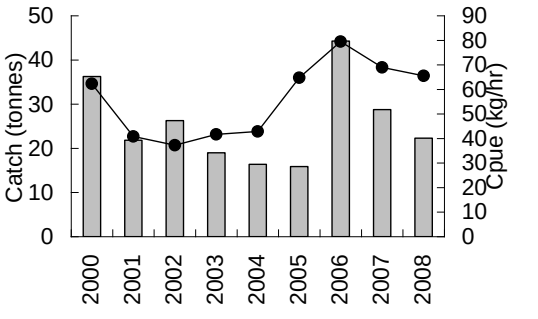
CPUE distribution



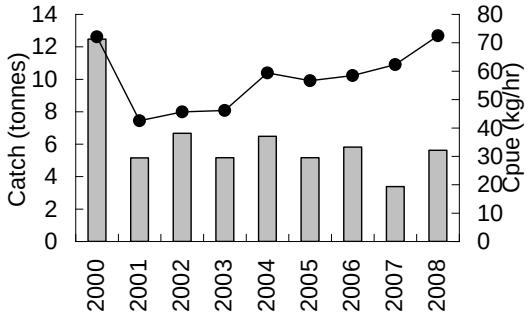
Sub-block 22A
Cape Pillar to the Lanterns



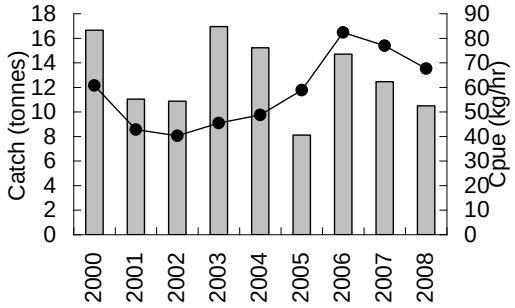
Sub-block 22B
The Lanterns to Eaglehawk Neck



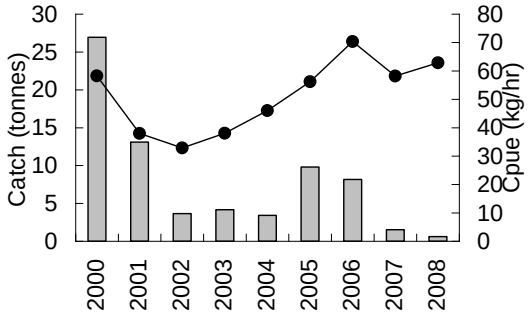
Sub-block 22C
Eaglehawk Neck to Deep Glen Bay



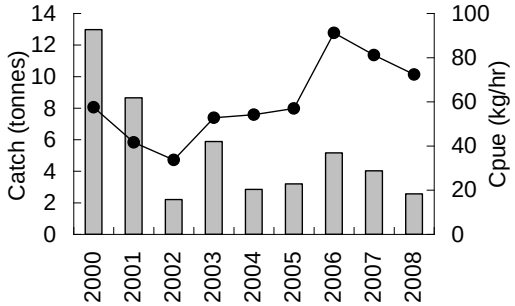
Sub-block 23A
Deep Glen Bay to Lagoon Bay



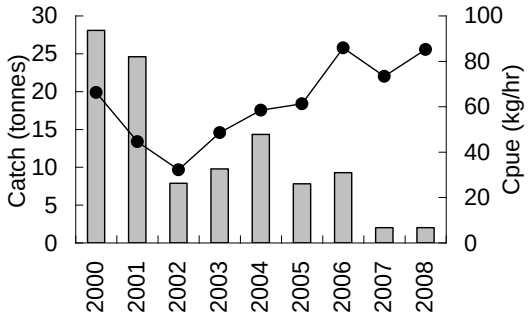
Sub-block 23B
Lagoon Bay to Marion Bay



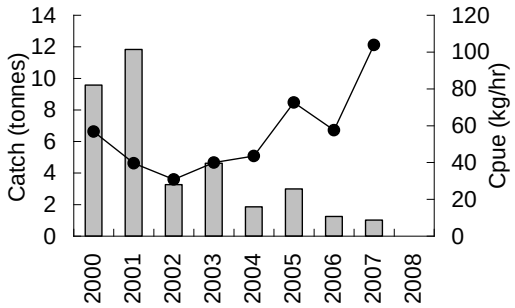
Sub-block 24A
Marion Bay to Rheban



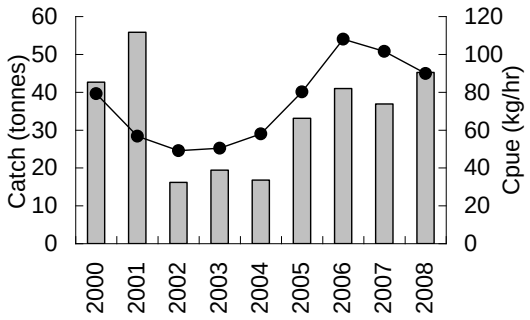
Sub-block 24B
Eastern shore of Mercury Passage



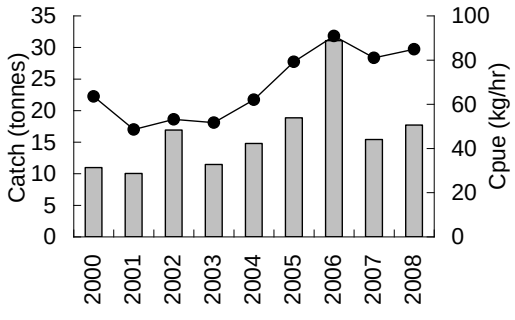
Sub-block 24C
Rheban to Cape Bougainville



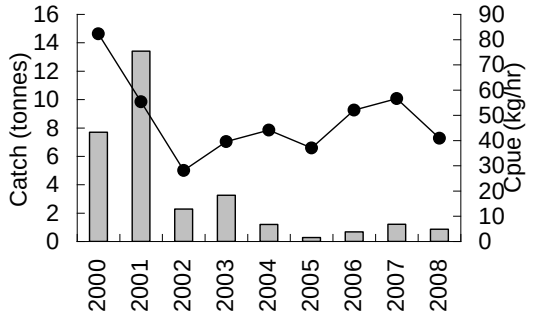
Sub-block 24D
north-east side of Maria Island



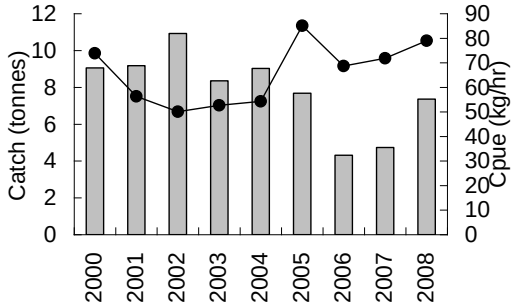
Sub-block 24E
south-east side of Maria Island



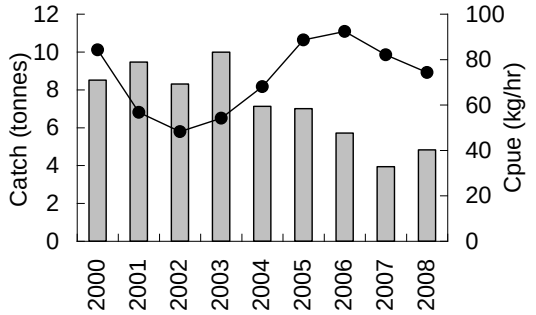
Block 26
Great Oyster Bay



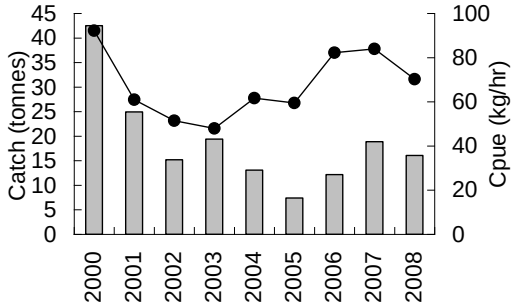
Sub-block 27A
south side of Schouten Island



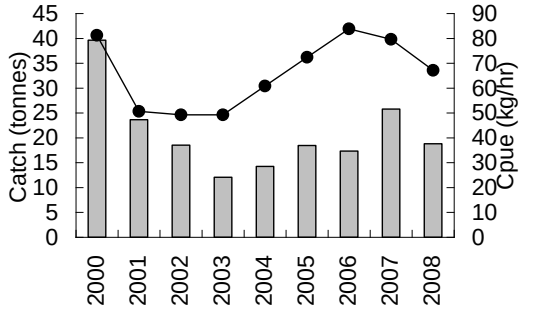
Sub-block 27B
east side of Schouten Island



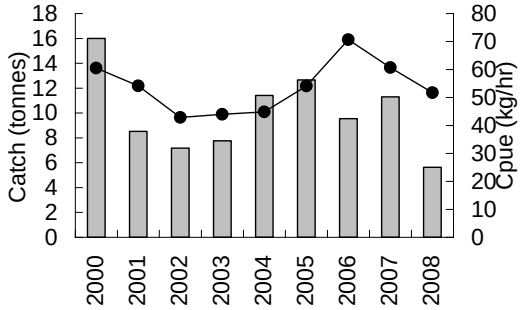
Sub-block 27C
Schouten Passage to Wineglass Bay



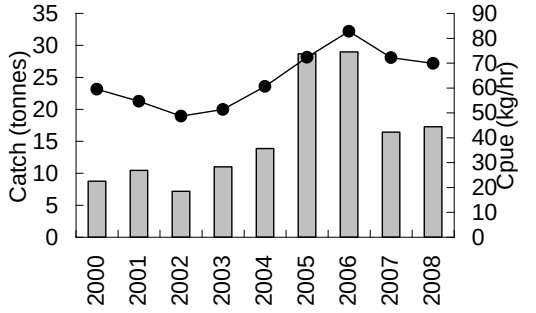
Sub-block 27D
Wineglass Bay to the Friendly Beaches



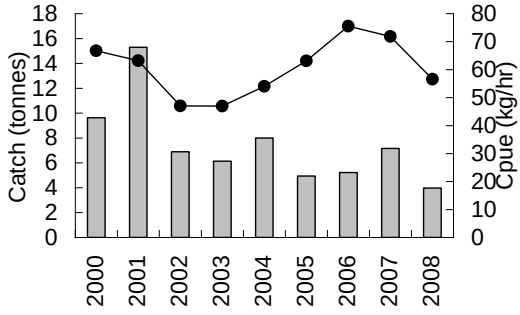
Block 28
Friendly Beaches to Long Point



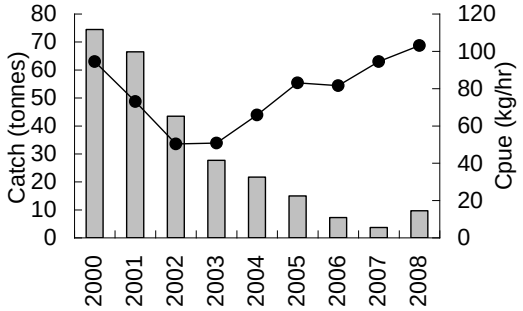
Sub-block 29A
Long Point to Templestowe Beach



Sub-block 29D

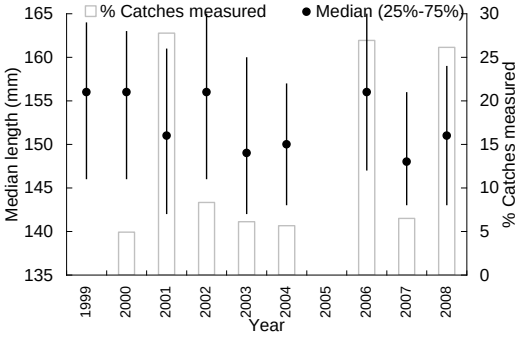


Sub-block 31A
Eddystone Point to Cape Naturaliste

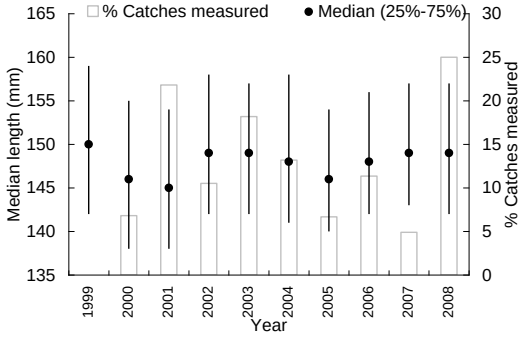


Eastern Zone – East Coast (Blocks 22-31)
Median length of catch

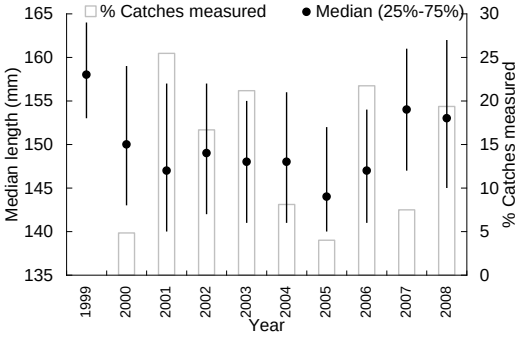
Sub-block 22A
Cape Pillar to the Lanterns



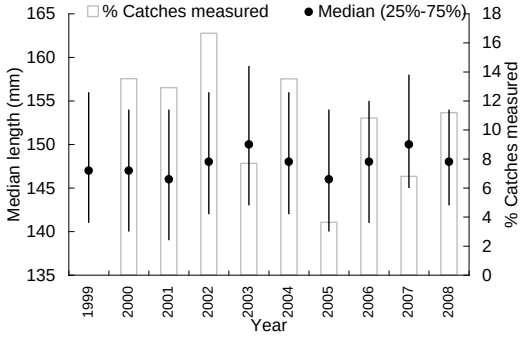
Sub-block 22B
The Lanterns to Eaglehawk Neck



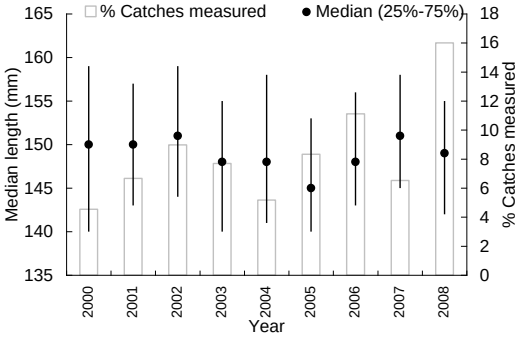
Sub-block 23A
Deep Glen Bay to Lagoon Bay



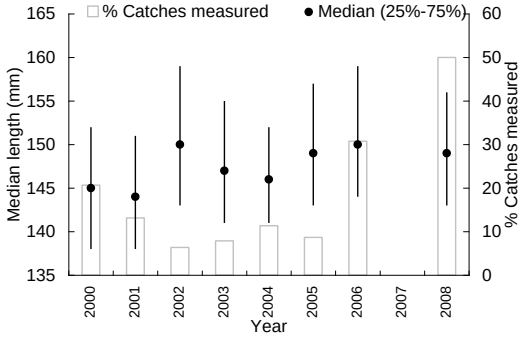
Sub-block 24D
north-east side of Maria Island



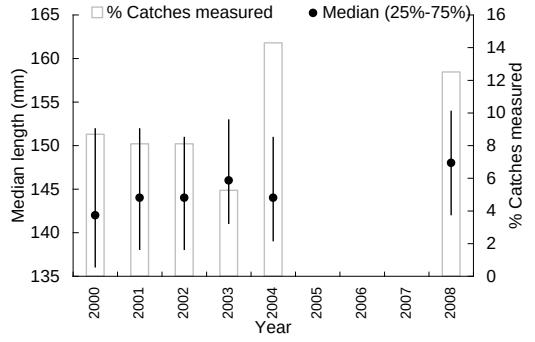
Sub-block 24E
south-east side of Maria Island



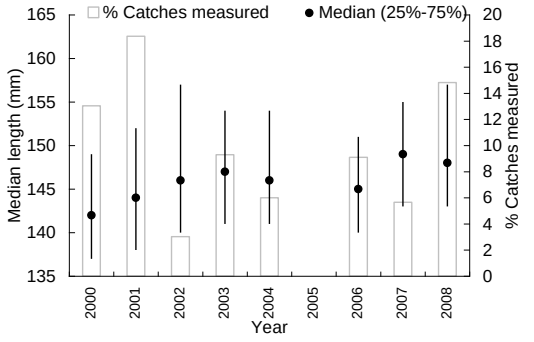
Sub-block 27A
south side of Schouten Island



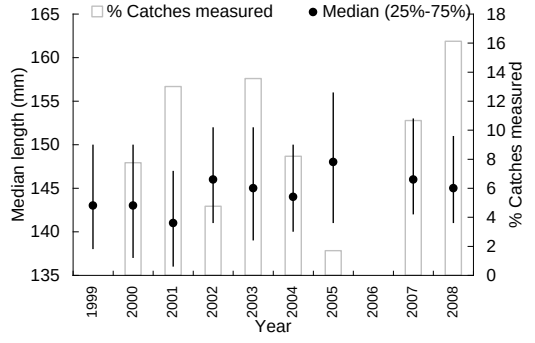
Sub-block 27B
east side of Schouten Island



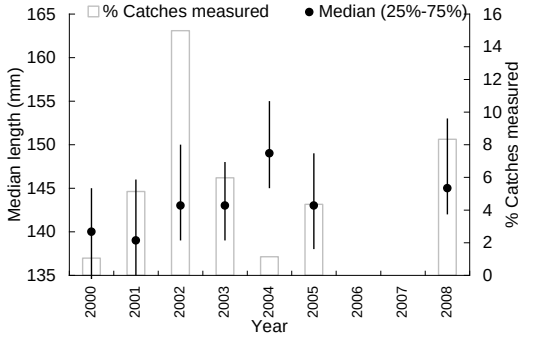
Sub-block 27C
Schouten Passage to Wineglass Bay



Sub-block 27D
Wineglass Bay to Friendly Beaches



Sub-block 31A
Eddystone Point to Cape Naturaliste



Western Zone blacklip fishery

Distribution of catch

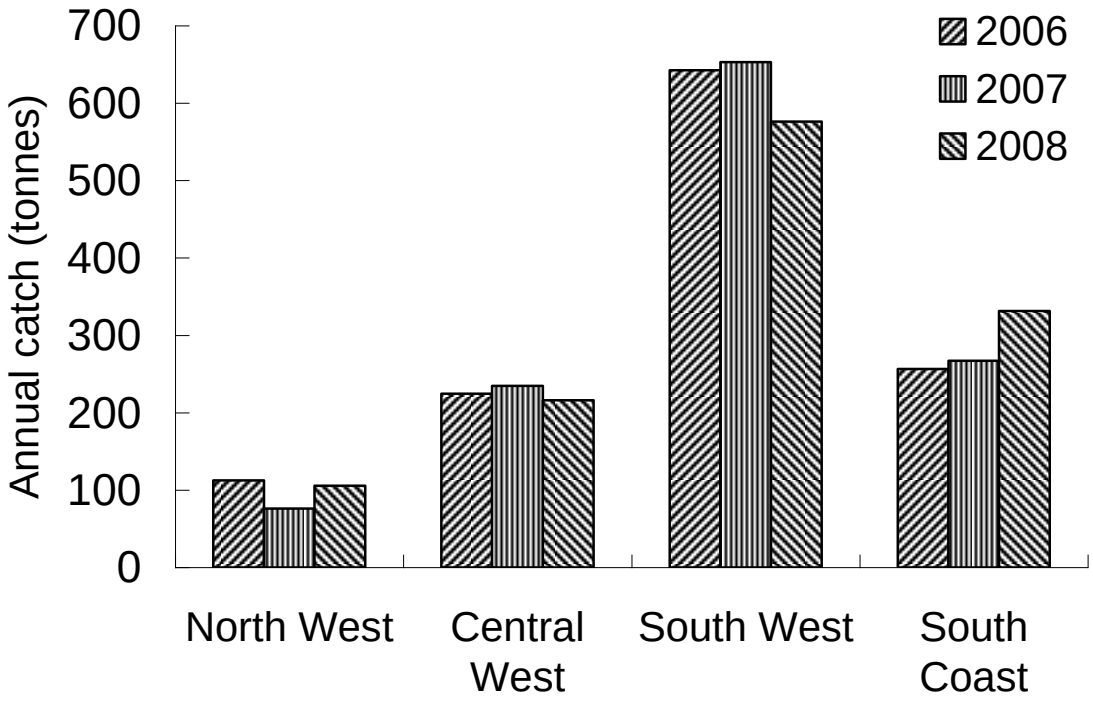
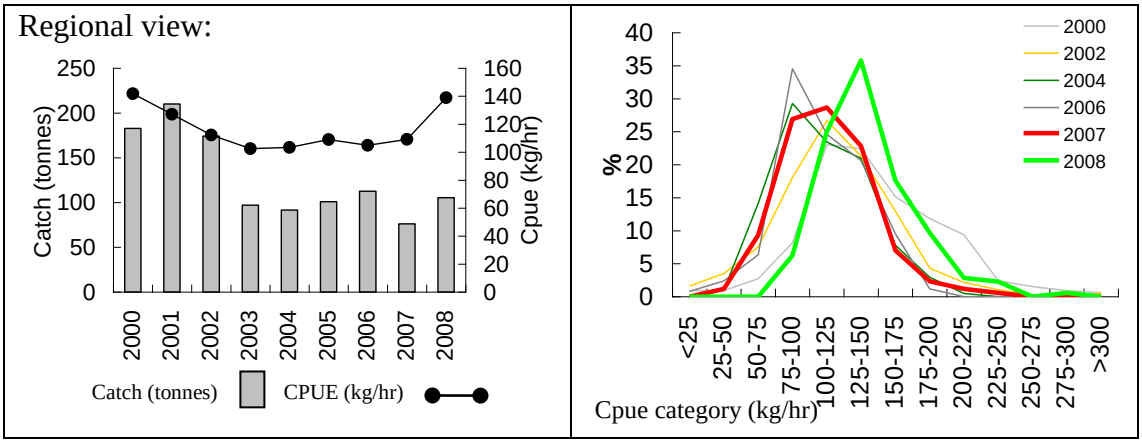


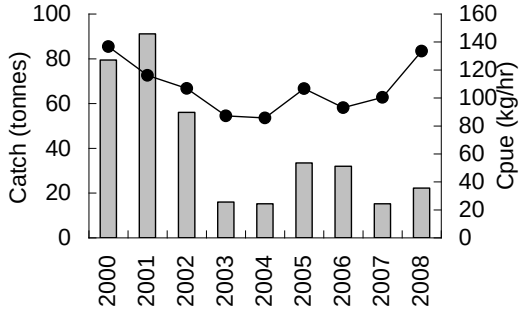
Figure 6. Distribution of catch by region, Western Zone 2006-2008. The annual TAC was 1260t during this period. For a description of the area covered by each region, see the Introduction (page 1).

There was a substantial redistribution of catch between the South West and the South Coast (Figure 6). The South West catch fell to 576t, but remained substantially greater than its 449t average (1985-2007). The Central West catch was 216t (average 224t) and North West catch was 105t (average 160t).

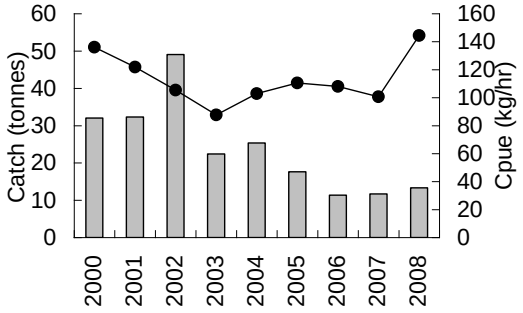
Western Zone - North West (Block 6, Sub-block 5D)
Catch and catch rates



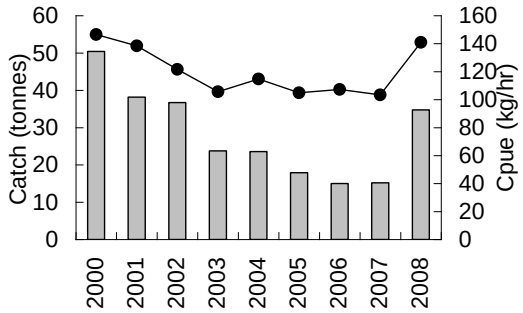
Sub-block 6A
Sundown to Temma



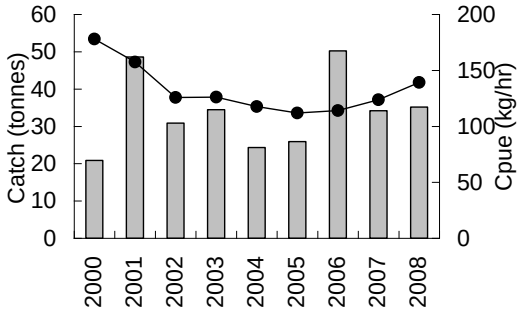
Sub-block 6B
Temma Harbour to north of Dawson River



Sub-block 6C
Dawson River to Wild Wave River

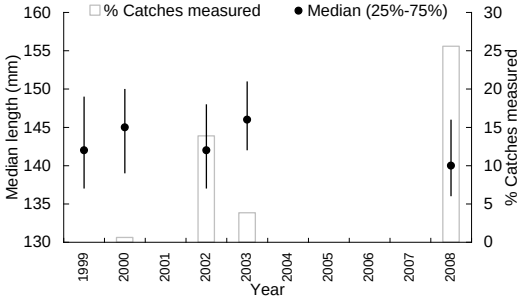


Sub-block 6D
Wild Wave River to Italian River, including Sandy Cape

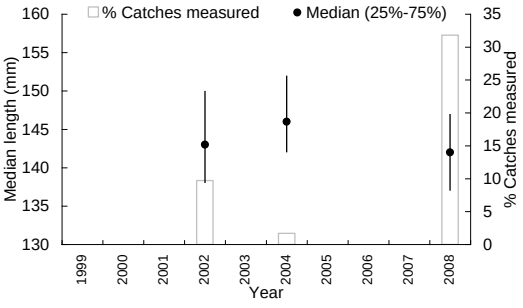


Western Zone - North West (Block 6, Sub-block 5D)
Median length of catch

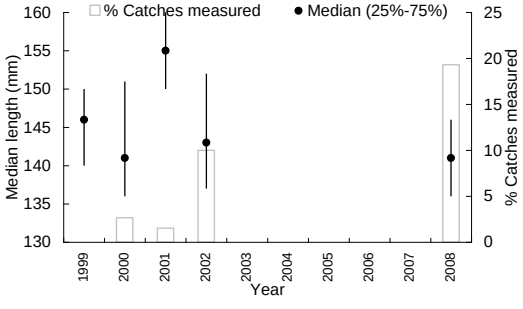
Sub-block 6A
Sundown to Temma



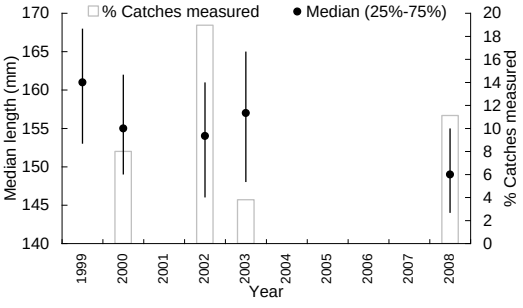
Sub-block 6B
Temma Harbour to north of Dawson River



Sub-block 6C
Dawson River to Wild Wave River

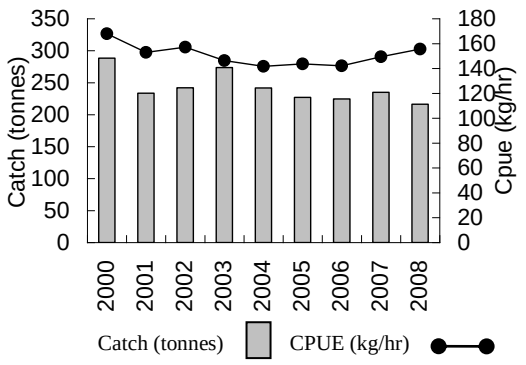


Sub-block 6D
Wild Wave River to Italian River, including Sandy Cape

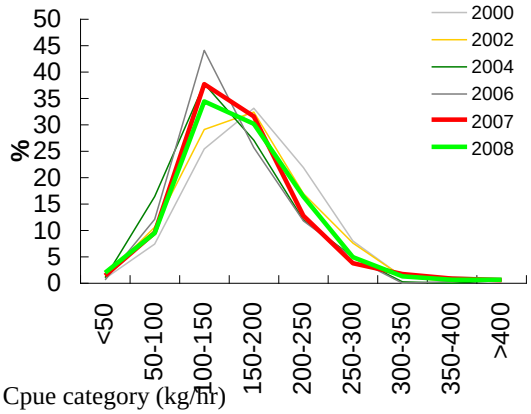


Western Zone - Central West (Blocks 7-9)

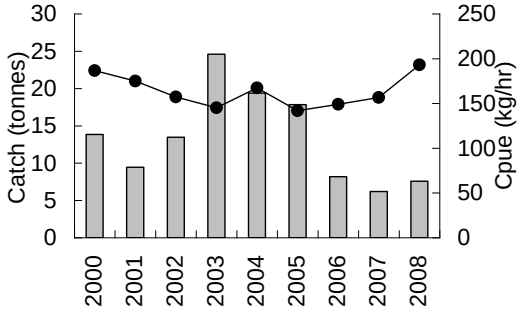
Regional view:



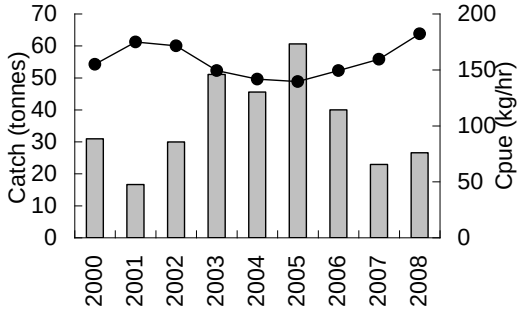
CPUE distribution:



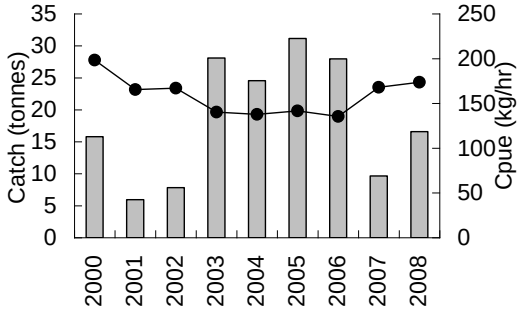
Sub-block 7A
Italian River to Pieman River



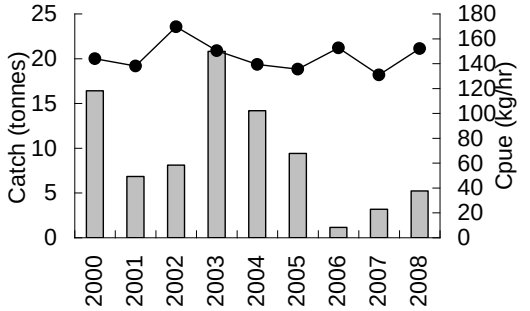
Sub-block 7B
Pieman to Ahrberg Bay



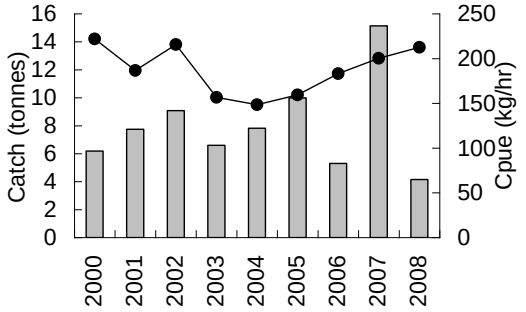
Sub-block 7C
Ahrberg Bay to Granville Harbour



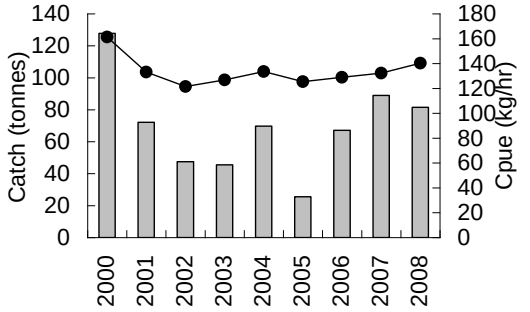
Sub-block 8A
Granville Harbour to Tasman Bay



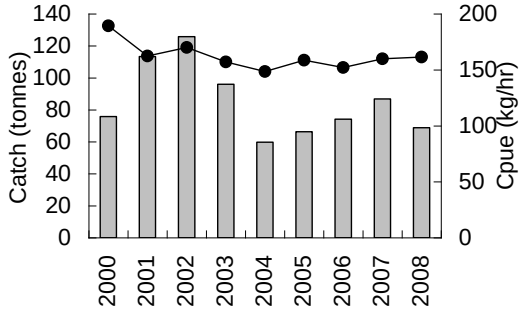
Sub-block 8B
Tasman Bay to Henty River



Sub-block 9B
Cape Sorell to Gorge Point

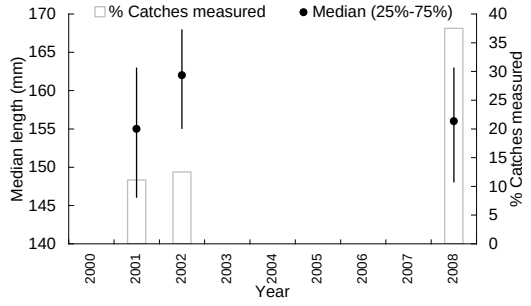


Sub-block 9C
Gorge Point to Point Hibbs

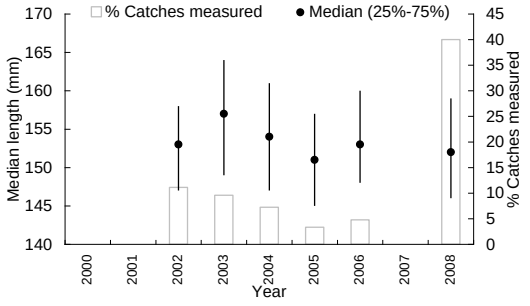


Western Zone - Central West (Blocks 7-9)
Median length of catch

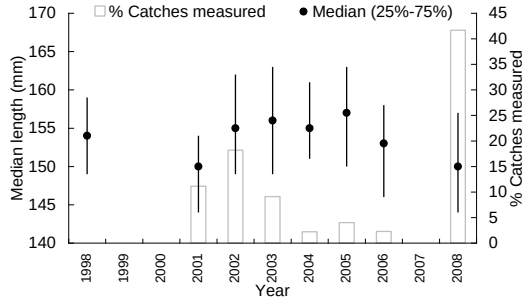
Sub-block 7A
Italian River to Pieman River



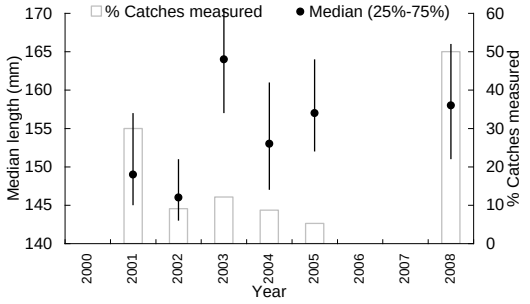
Sub-block 7B
Pieman to Ahrberg Bay



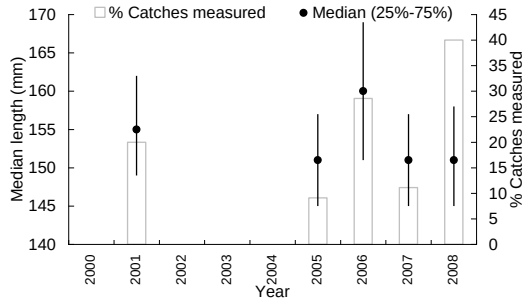
Sub-block 7C
Ahrberg Bay to Granville Harbour



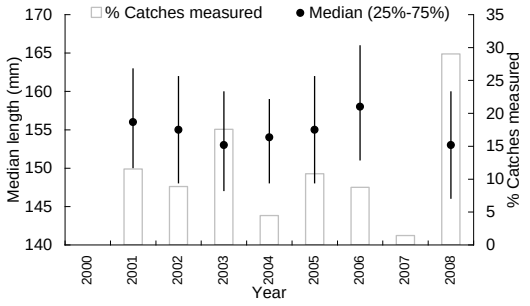
Sub-block 8A
Granville Harbour to Tasman Bay



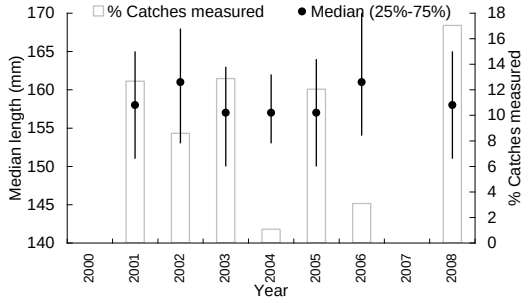
Sub-block 8B
Tasman Bay to Henty River



Sub-block 9B
Cape Sorell to Gorge Point

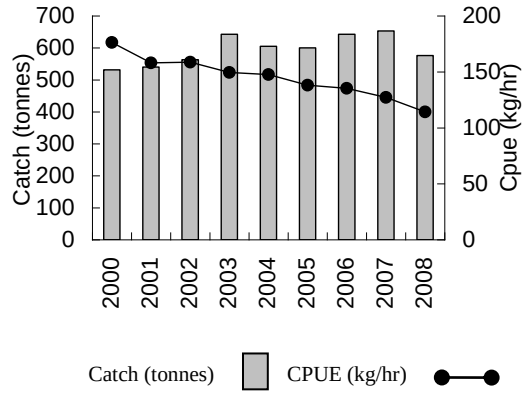


Sub-block 9C
Gorge Point to Point Hibbs

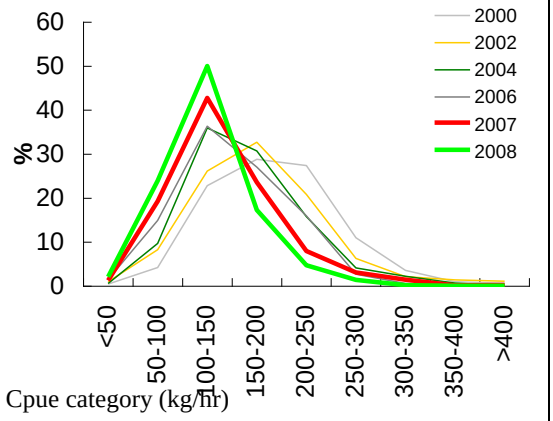


Western Zone - South West (Blocks 10-11, Sub-block 12A)

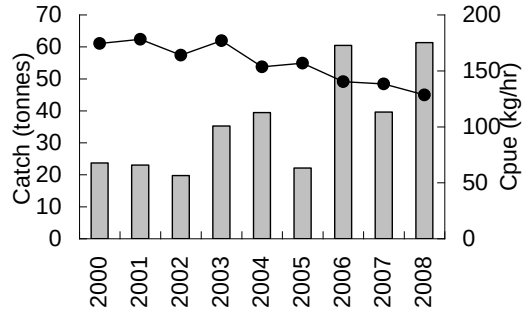
Regional view:



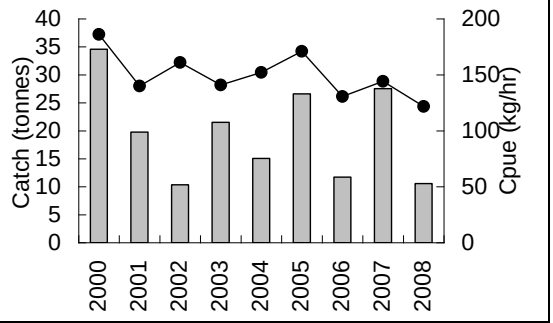
CPUE distribution:



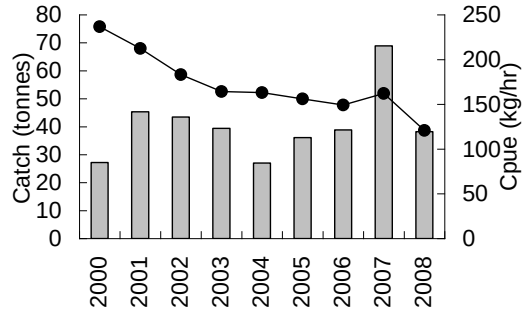
Sub-block 10A
Point Hibbs to Endeavour Bay



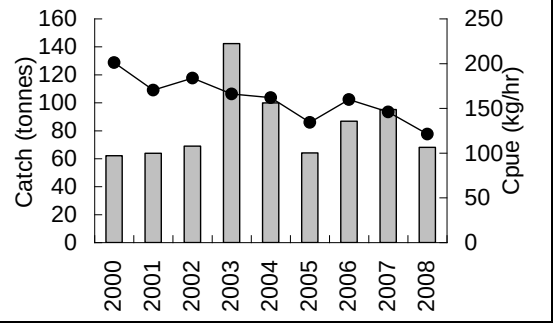
Sub-block 10B
Endeavour Bay to High Rocky Point



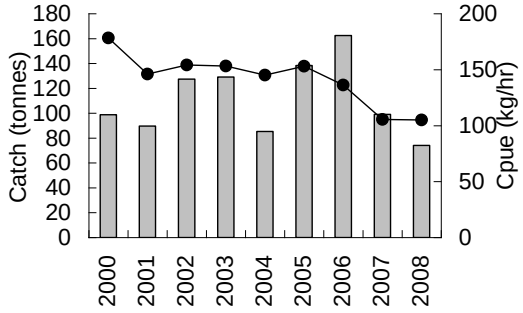
Sub-block 10C
High Rocky Point to Mainwaring River



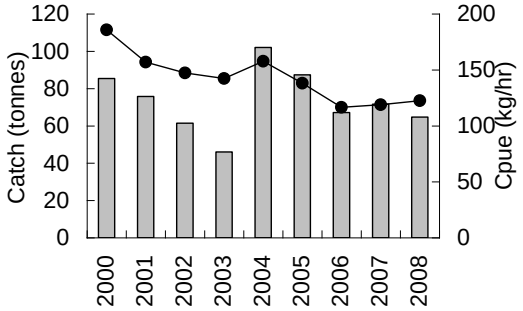
Sub-block 10D
Mainwaring River to Low Rocky Point



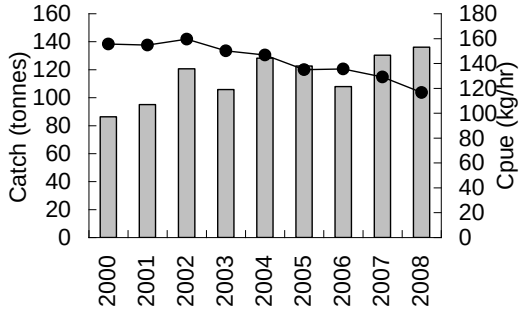
Sub-block 11A
Low Rocky Point to Elliott Point



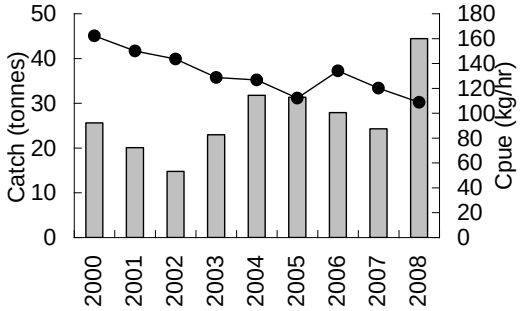
Sub-block 11B
Elliott Point to Svenor Gulches



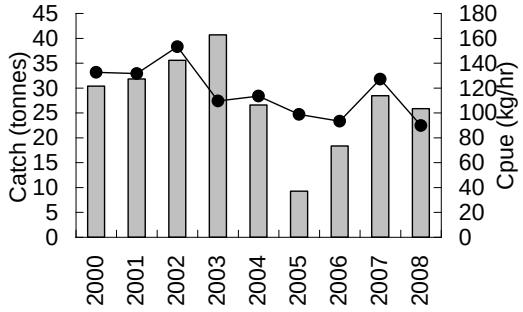
Sub-block 11C
Svenor Gulches to Point St Vincent



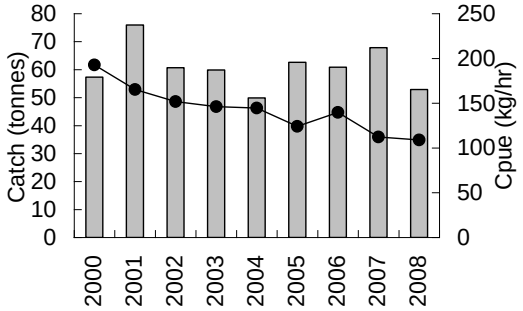
Sub-block 11D
Hilliard Head to Faults Bay



Sub-block 11E
Point St Vincent to Hilliard Head, including Port Davey

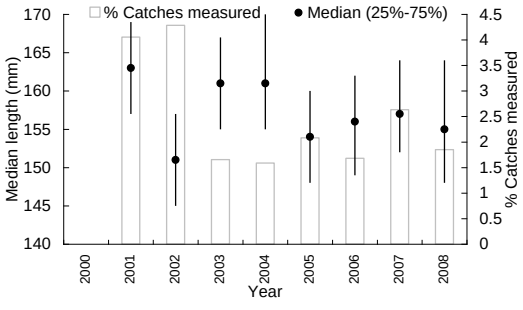


Sub-block 12A
Faults Bay to South West Cape

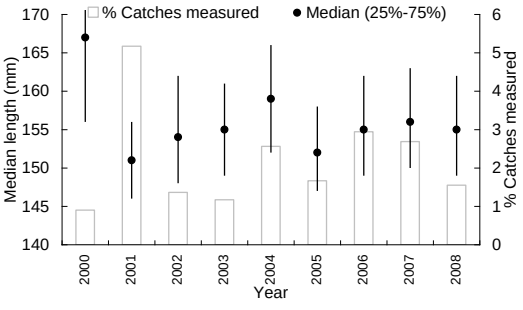


Western Zone - South West (Blocks 10-11, Sub-block 12A)
Median length of catch

Sub-block 10D
Mainwaring River to Low Rocky Point

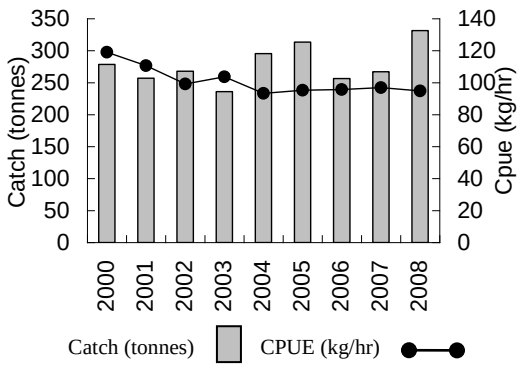


Sub-block 11A
Low Rocky Point to Elliott Point

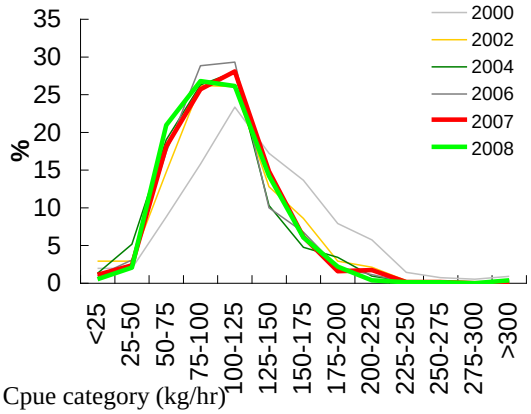


Western Zone - South Coast (Sub-blocks 12B, 12C, 12D, 13A, 13B)

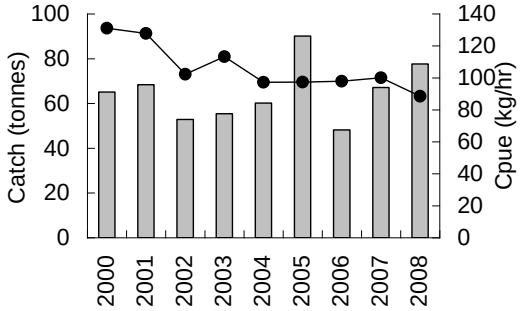
Region view:



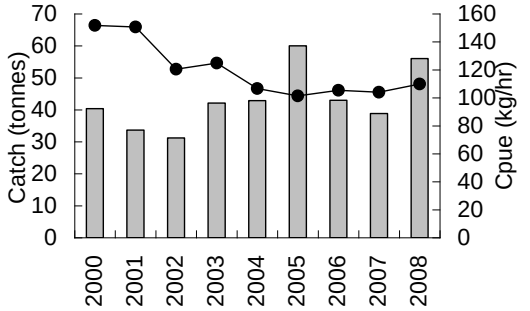
CPUE distribution:



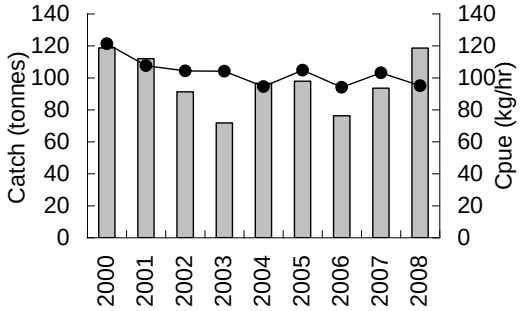
Sub-block 12B
South West Cape to Cox ‘s Bluff



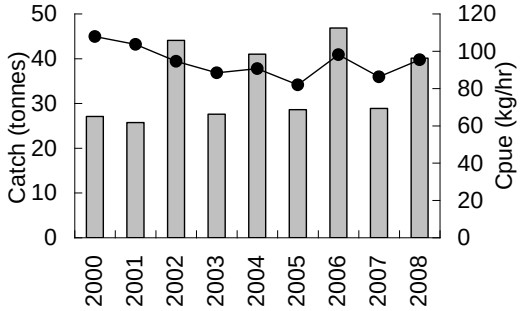
Sub-block 12C
Maatsuyker Group



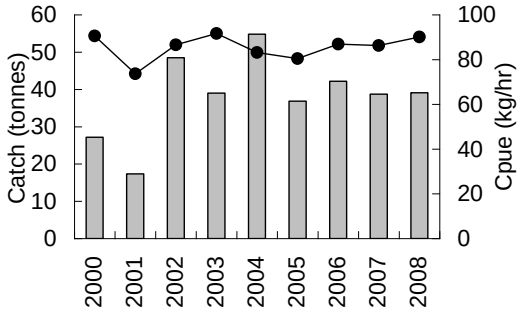
Sub-block 12D
Cox’s Bluff to Prion Beach



Sub-block 13A
Prion Beach to South Cape

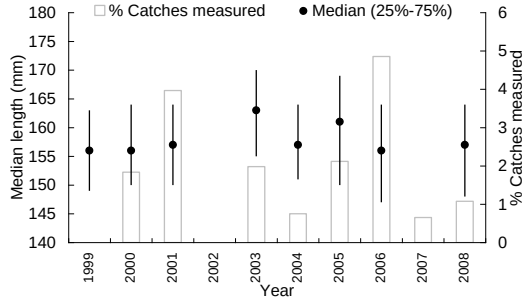


Sub-block 13B
South Cape to Whale Head

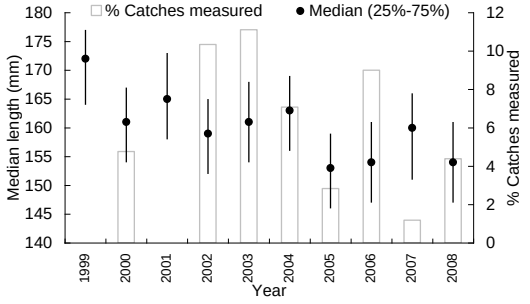


Western Zone - South Coast (Block 12, Sub-blocks 13A, 13B)
Median length of catch

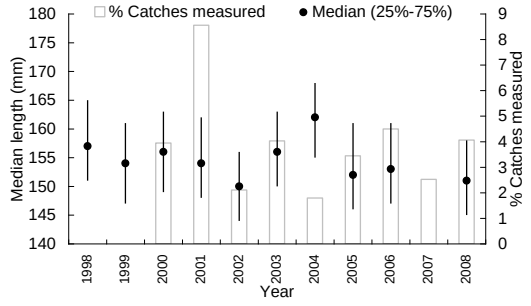
Sub-block 12B
South West Cape to Cox ‘s Bluff



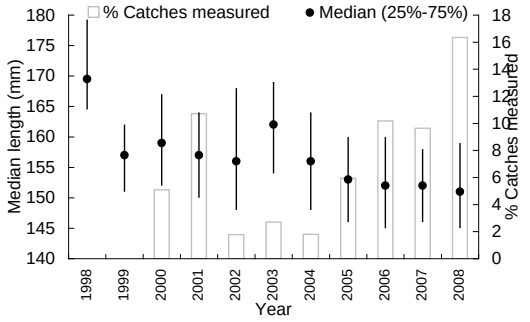
Sub-block 12C
Maatsuyker Group



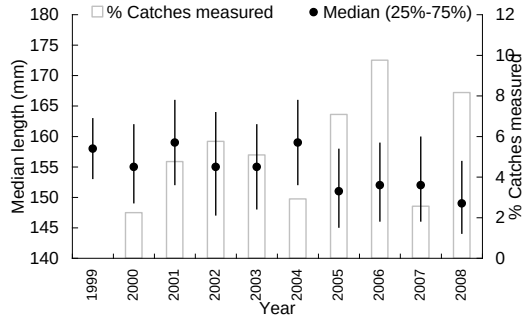
Sub-block 12D
Cox’s Bluff to Prion Beach



Sub-block 13A
Prion Beach to South Cape



Sub-block 13B
South Cape to Whale Head



Northern Zone blacklip fishery

Distribution of catch

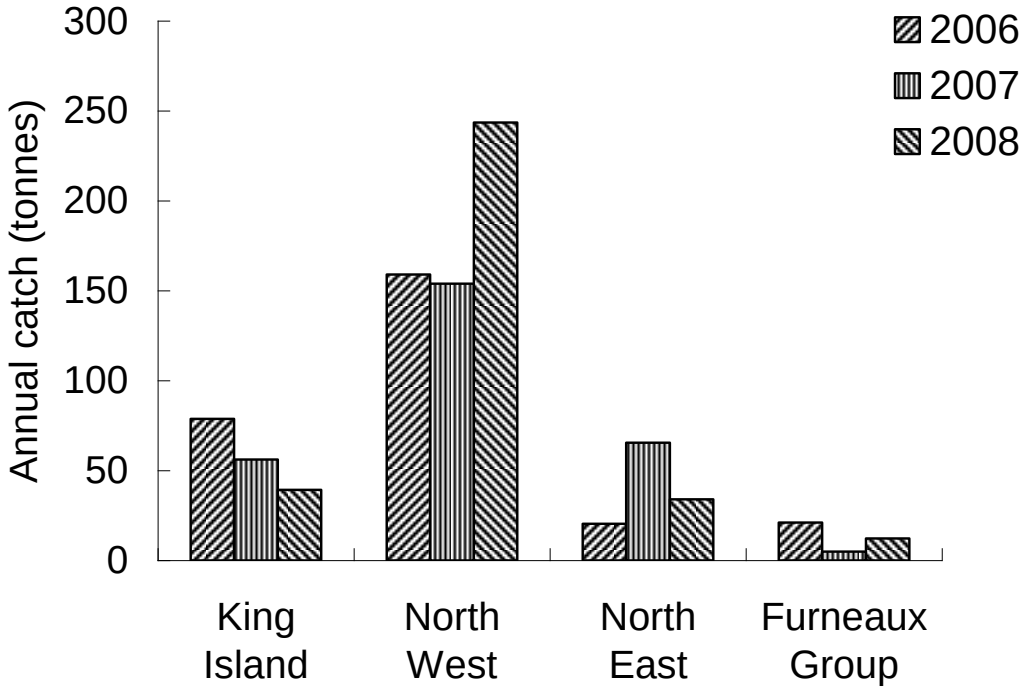


Figure 7. Distribution of catch by region, Northern Zone 2006-2008. The Northern Zone TAC was increased from 280t to 332.5t in 2008.

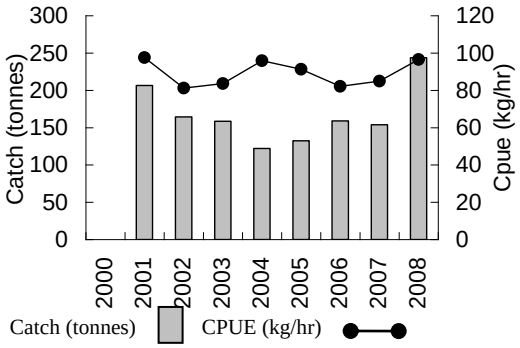
Since the introduction of the Northern Zone in 2001, most catch has come from the North West and King Island. In 2008, the Northern Zone TAC was increased from 280t to 332.5t, with a cap of 152.5t placed on catches from Block 5 in the North West. In Block 5, the size limit was reduced from 132mm to 127mm for divers fishing under permit, automatically increasing stock levels there. In 2008, the North West regional catch was 244t.

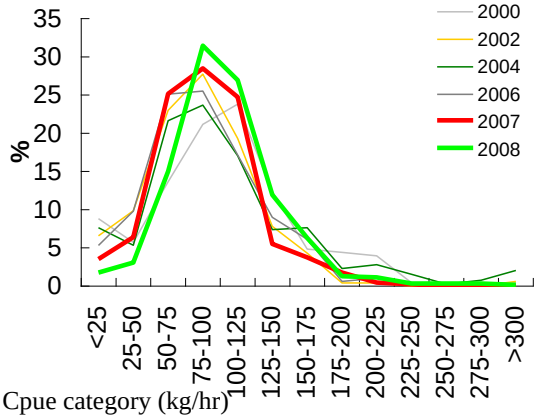
On King Island, landings continued to decline following the implementation of AVG quarantine restrictions on catch from the island in 2007. The 2008 catch was 39t, approximately 90t lower than the peak levels of 2003 and 2004.

In the North East, the very high catch level of the previous year (66t) was not sustained, and catches returned to a more normal level (34t). The Furneaux Group continued to supply small amounts of catch (12t).

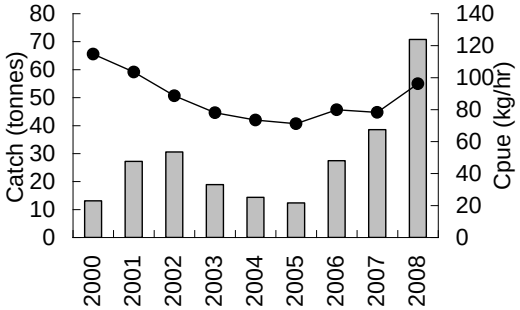
Northern Zone - North West (Blocks 5, 47- 49)
Catch and catch rates

Regional view:

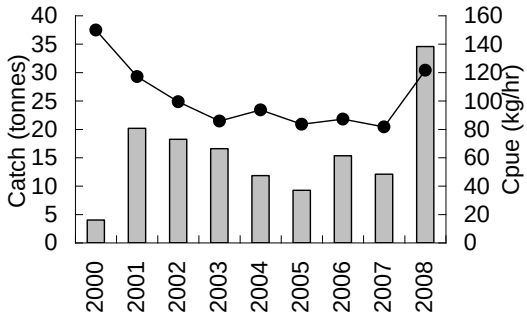




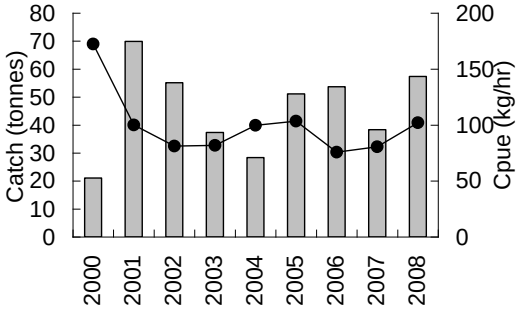
Sub-block 5A
Woolnorth Point to Studland Bay



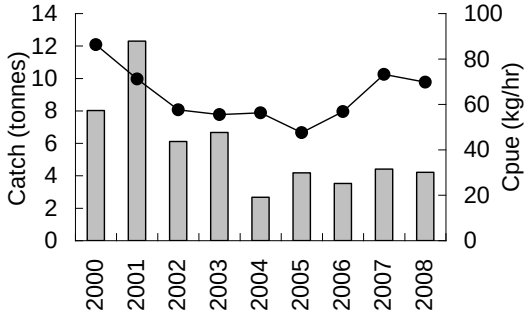
Sub-block 5B
Studland Bay to Greens Beach, including Mt Cameron West



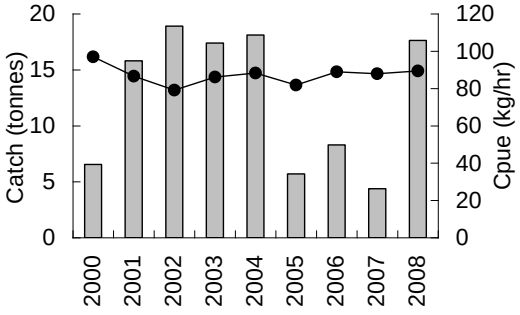
Sub-block 5C
Greens Beach to Arthur River



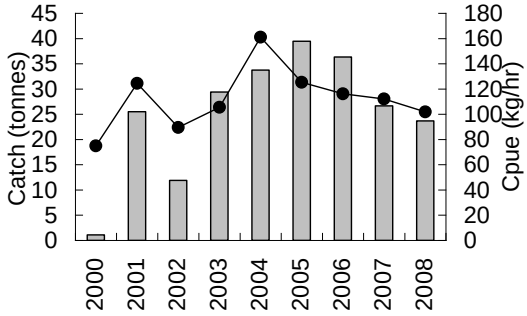
Sub-block 48C
Hunter Island to Robbins Island



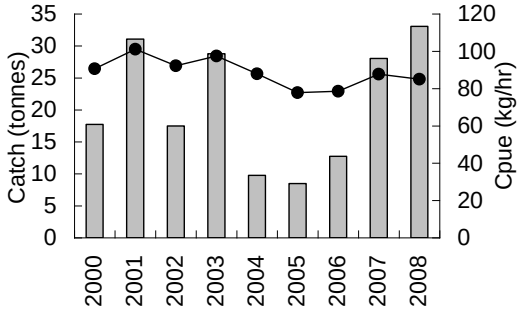
Sub-block 49A
Three Hummock Island



Sub-block 49B
Northern part of Hunter Island

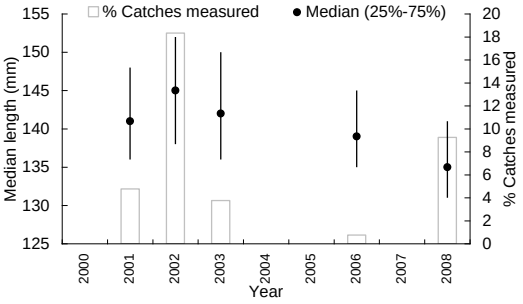


Sub-block 49C
South-western Hunter Island

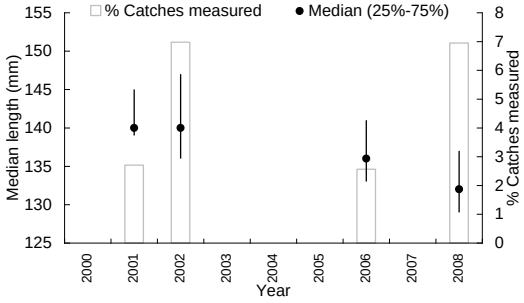


Northern Zone – North West (Blocks 5, 47- 49)
Median length of catch

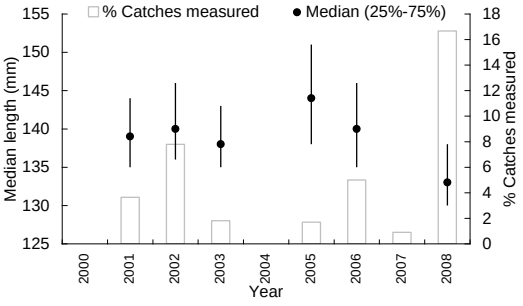
Sub-block 5A
Woolnorth Point to Studland Bay



Sub-block 5B
Studland Bay to Greens Beach, including Mt Cameron West

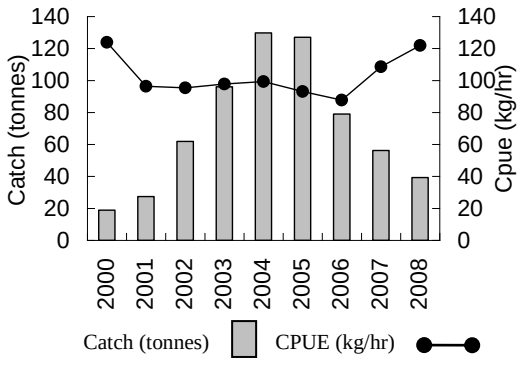


Sub-block 5C
Greens Beach to Arthur River

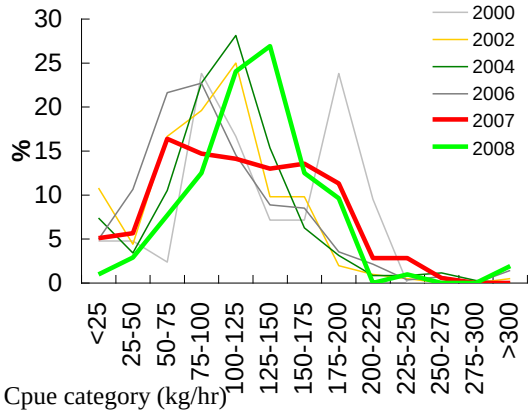


Northern Zone - King Island (Blocks 1-4)

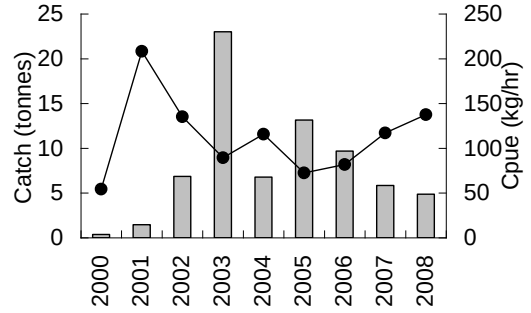
Regional view:



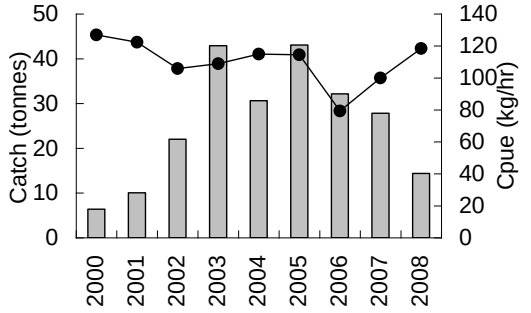
CPUE distribution:



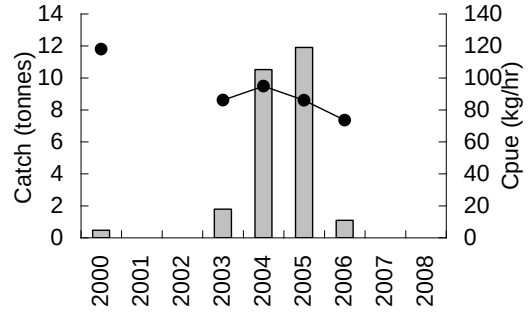
Sub-block 1C
North-west King Island



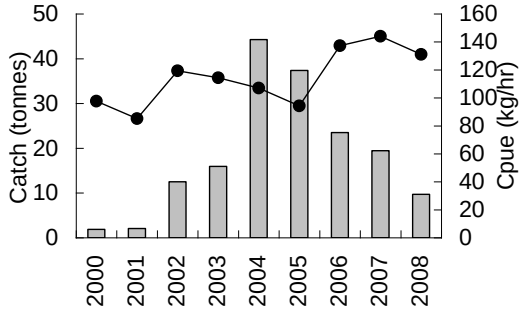
Sub-block 3A
west King Island



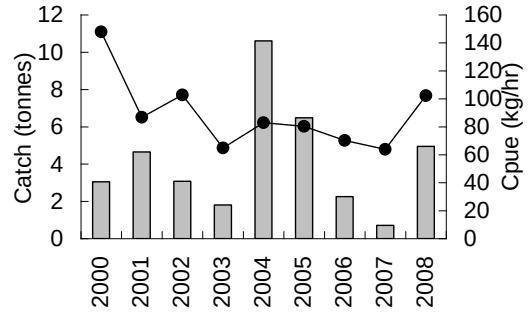
Sub-block 3B
South-west King Island



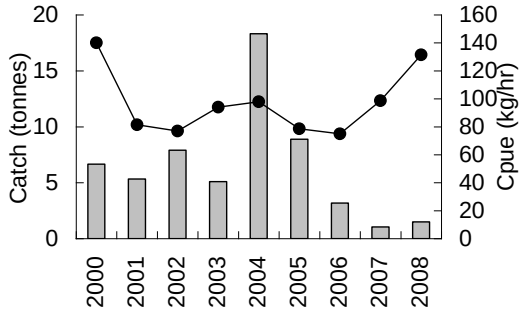
Sub-block 3C
South-west King Island



Sub-block 4B
South-east King Island

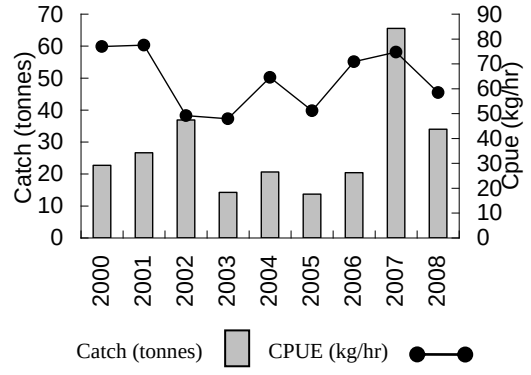


Sub-block 4C
South-east King Island

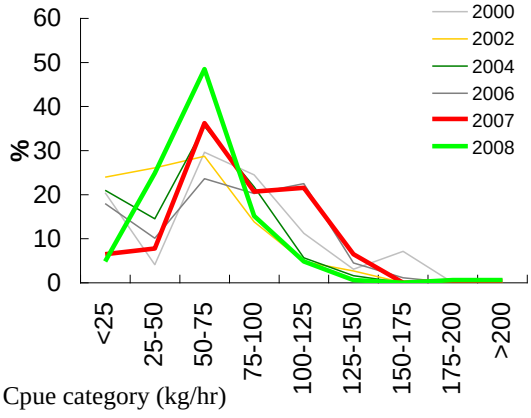


Northern Zone - North East (Sub-block 31B, Blocks 39, 40)

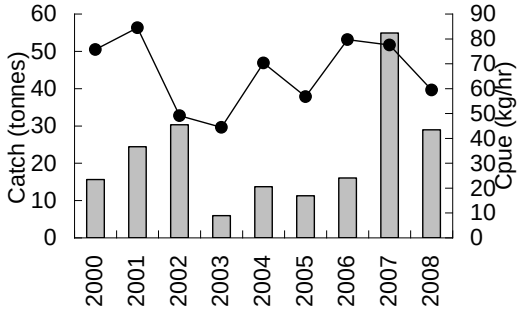
Regional view:



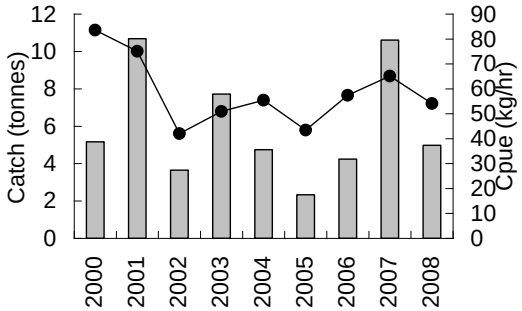
CPUE distribution:



Sub-block 31B
Cape Naturaliste to Little Musselroe Bay

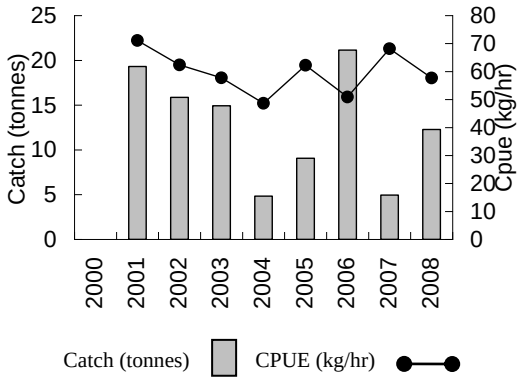


Sub-block 39A
Little Musselroe Bay to Petal Point

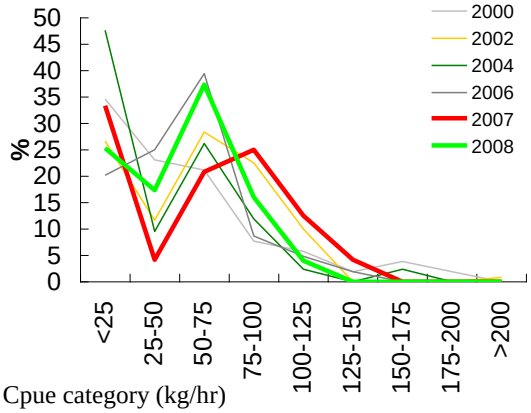


Northern Zone - Furneaux Group (Blocks 32-36, Sub-blocks 38A, 38B)

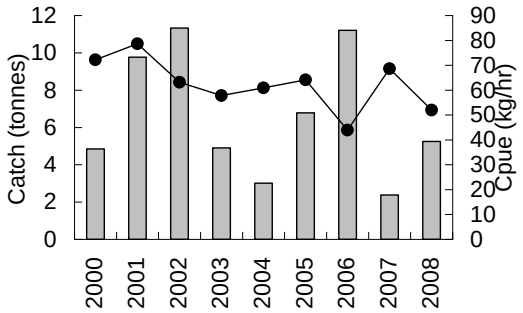
Regional view:



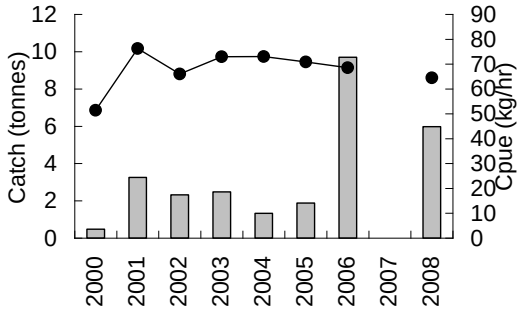
CPUE distribution:



Block 33
South-east Furneaux Group

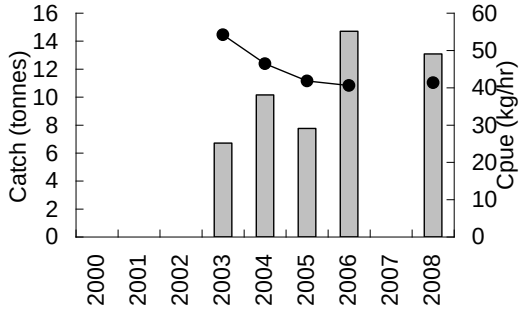


Sub-block 38A
East side of Flinders Island, inc Babel Island

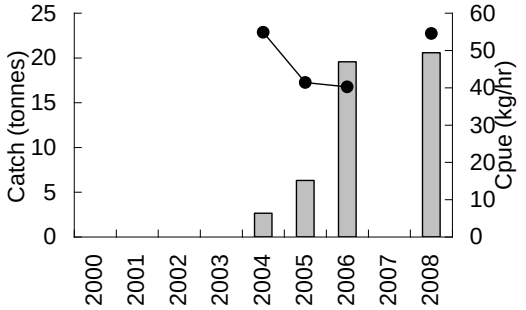


Bass Strait Zone blacklip fishery

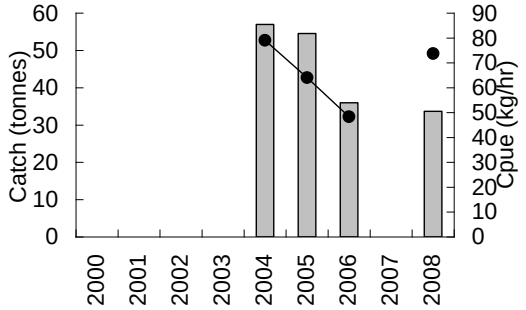
Regional view:
Central North (Blocks 40-46)



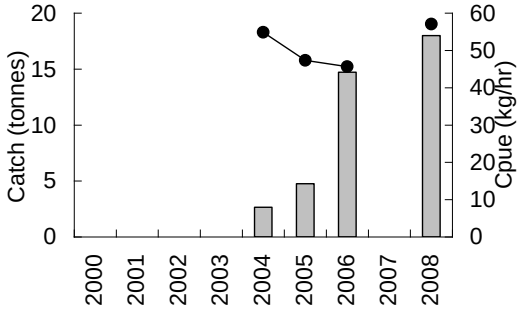
Regional view:
Furneaux Group: (Blocks 37, 38A)



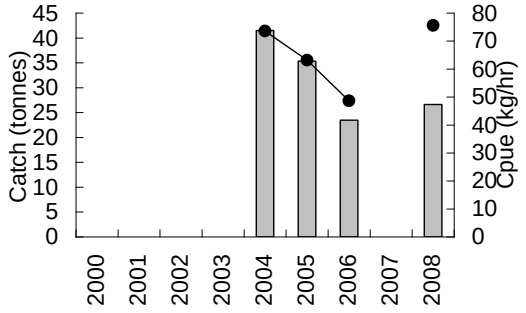
Regional view:
Bass Strait Islands (Blocks 50-56)



Sub-block 37D (Sisters, NE Flinders Island)



Block 53
Hogan Group



Greenlip fishery

Distribution of the 2008 catch (caps) between the four regions was fixed at the following levels:

King Island – 30t
North West – 30t
North East – 23t
Furneaux Group – 42t

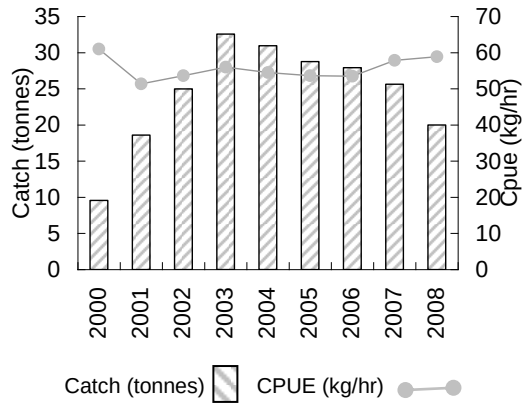
An additional 20t was made available from sub-block 48A and Block 47 in the North West from 1 November 2006, at a reduced size limit (132mm).

Annual catches (tonnes, estimated weights):

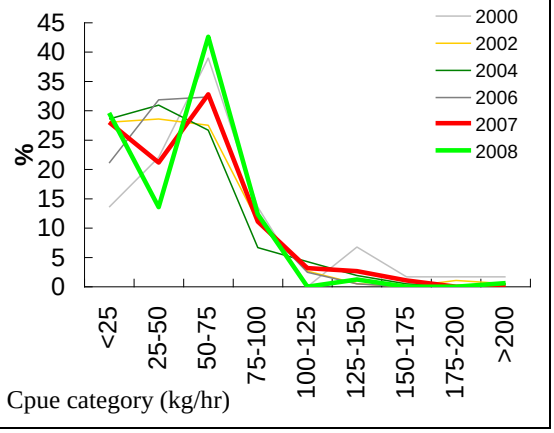
Year	King Island	North West	North East	Furneaux Group
2000	9.6	49.1	38.9	42.5
2001	18.6	46.8	30.4	44.2
2002	25.0	39.9	31.3	43.3
2003	32.6	34.3	35.3	37.6
2004	31.0	29.3	31.4	36.8
2005	28.8	32.4	19.4	42.4
2006	27.9	39.1	16.2	39.6
2007	25.6	33.3	33.5	31.1
2008	20.0	41.1	24.4	34.9

Greenlip - King Island (Blocks 1-4)
Catch and catch rates

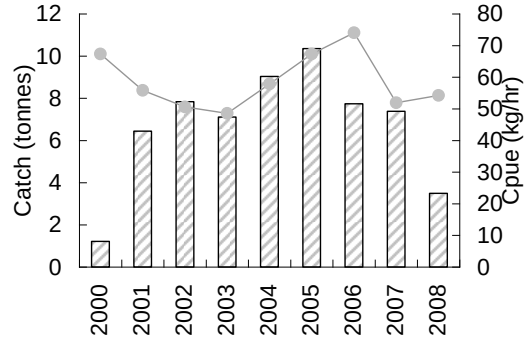
Regional view:



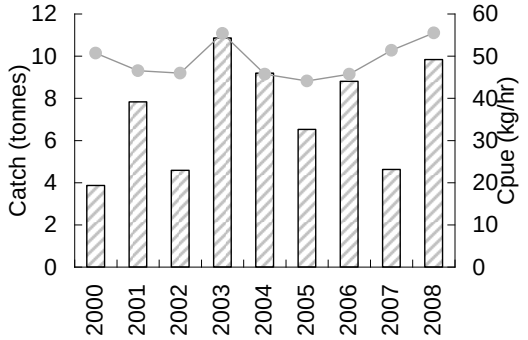
CPUE distribution:



Sub-block 1B
north-west King Island

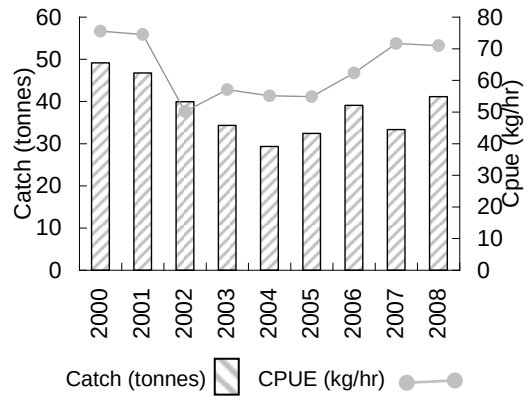


Sub-block 2C
east King Island

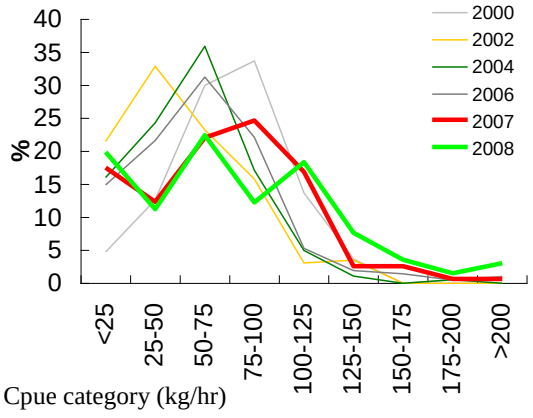


Greenlip - North West (Blocks 5, 47-48)

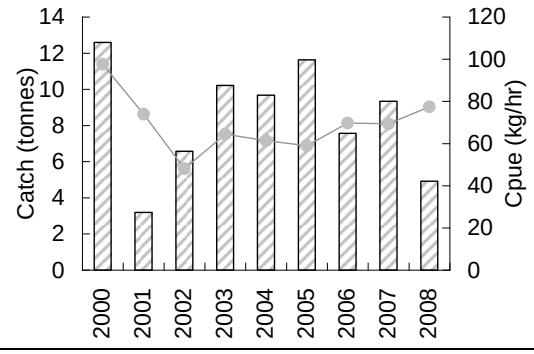
Regional view:



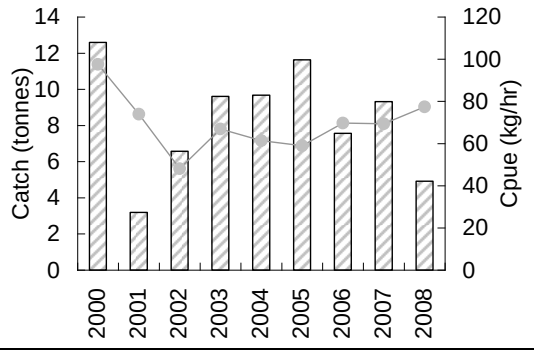
CPUE distribution:



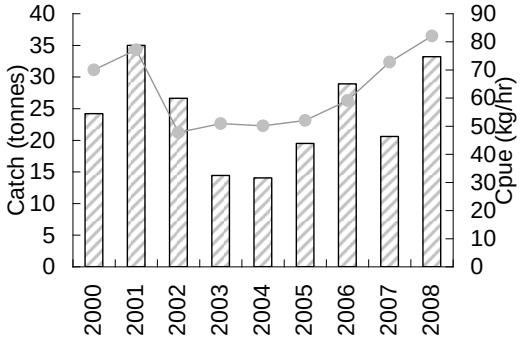
Block 5
west of Woolnorth Point



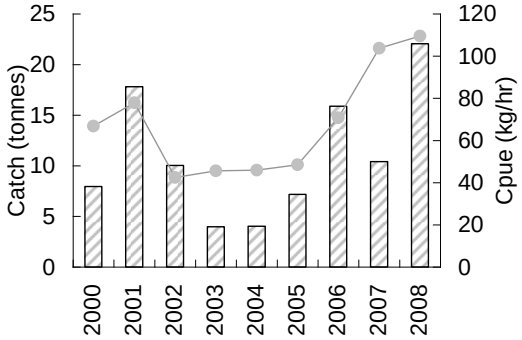
Sub-block 5A
west of Woolnorth Point



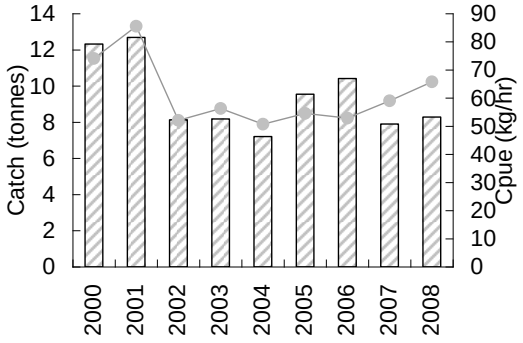
Block 48
Woolnorth Point to Duck River, including Black Reef



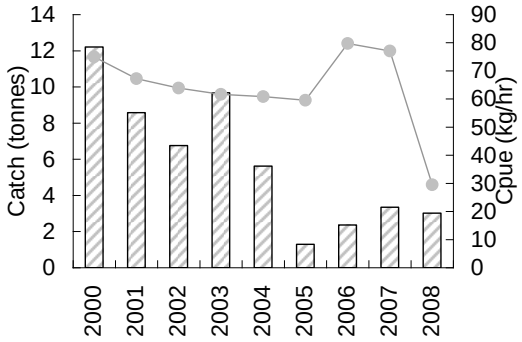
Sub-block 48A
Black Reef



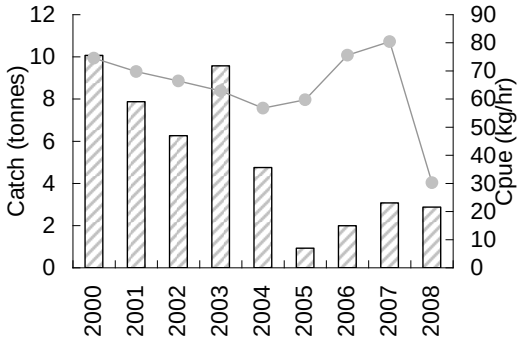
Sub-block 48C
Woolnorth to Robbins Island



Block 49
Woolnorth Point to Hunter Island, including Three Hummock Is,

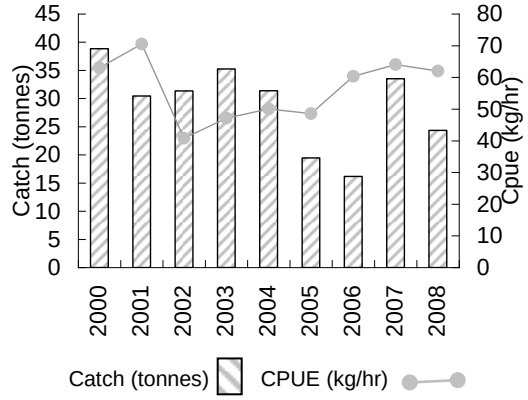


Sub-block 49C
west of Hunter island

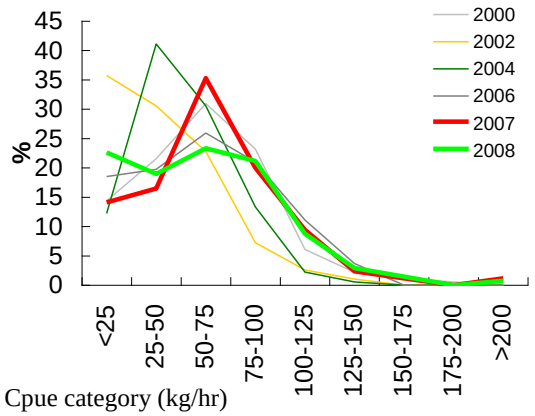


Greenlip - North East (Blocks 31, 39, 40)

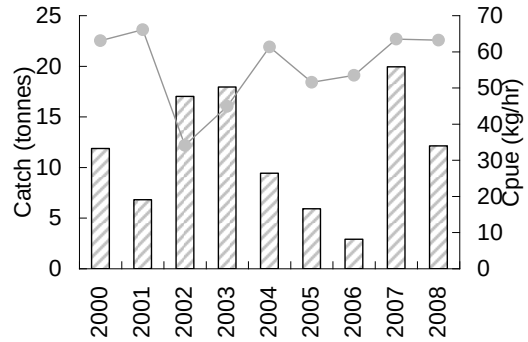
Regional view:



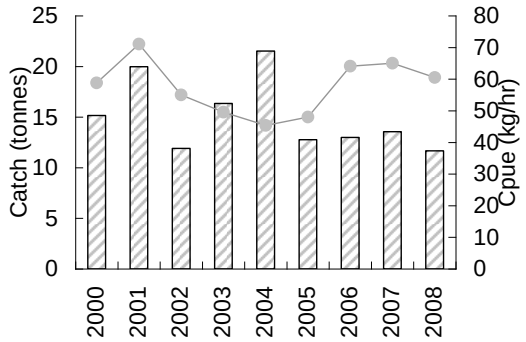
CPUE distribution:



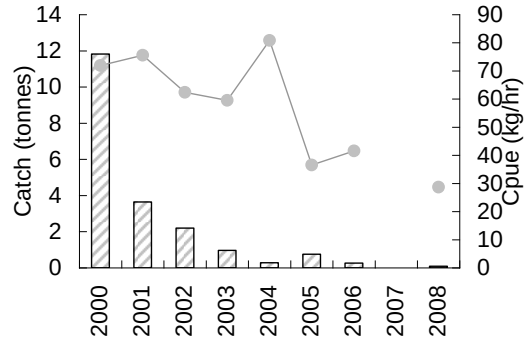
Sub-block 31B
Cape Naturaliste to Little Musselroe, Swan Is.



Sub-block 39A
Petal Pont to Little Musselroe

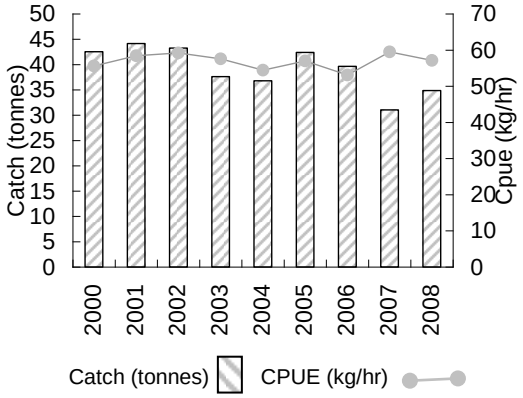


Block 40
Tomahawk to Waterhouse Beach

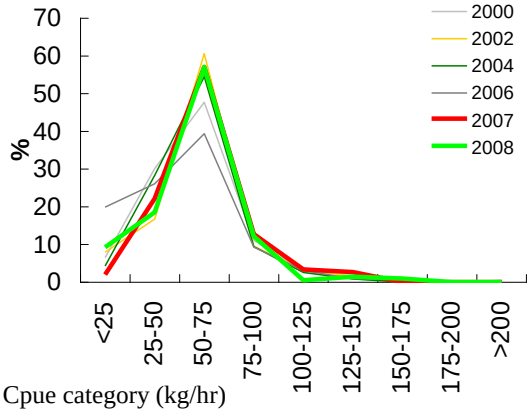


Greenlip – Furneaux Group (Blocks 32-38)

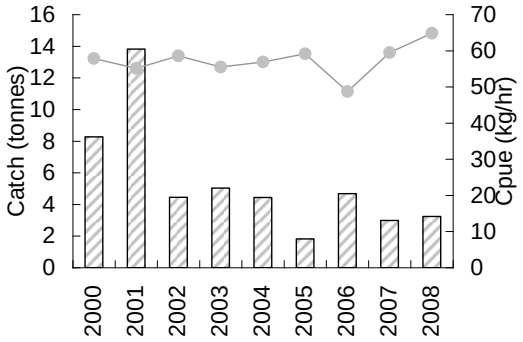
Regional view:



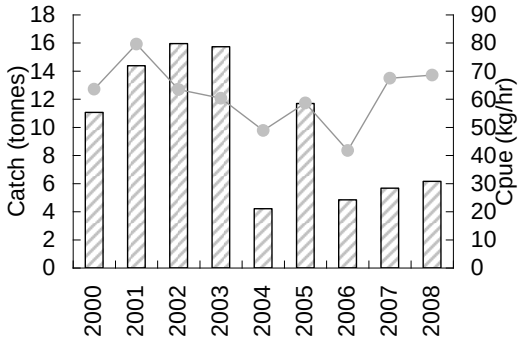
CPUE distribution:



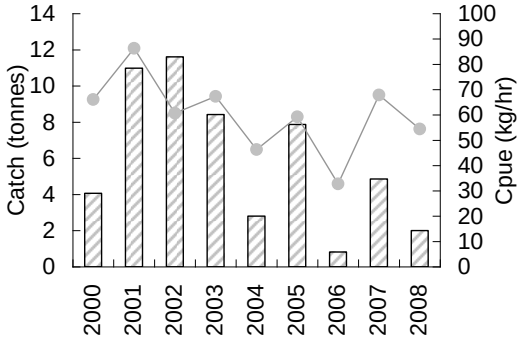
Block 32
western side of Clarke Is, Armstrong Passage



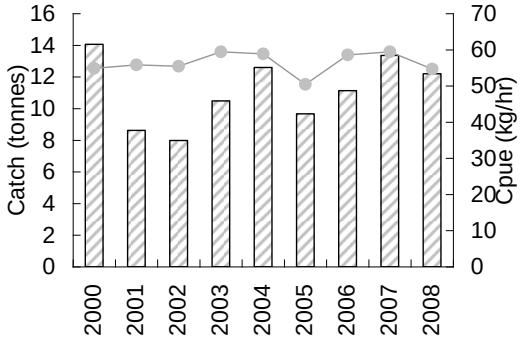
Block 33
south east Clarke, Cape Barren Islands



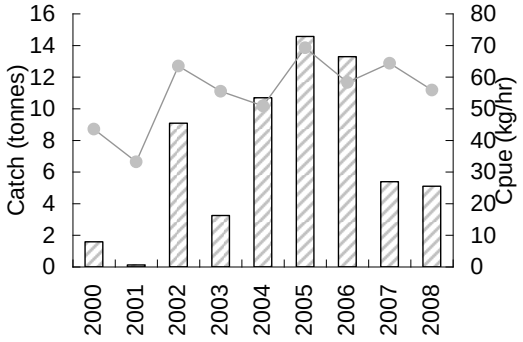
Sub-block 33A
east Clarke Island



Block 35
Franklin Sound



Block 38
north-east Flinders Island



4. Appendices

Appendix 1: Interpreting graphical information

Catch and catch rate by region, block and sub-block.

Catch and catch rate information is shown across a range of geographical scales ranging from large (regional) to small (sub-block) where relevant (*i.e.* catches consistently larger than 10t pa, or six or more divers contributed to the catch). Figure 8 shows catch and catch rates for the last eight years for sub-blocks. The vertical columns show catch in tonnes, for the period 2000-2007. The black line with balls shows catch rates (CPUE) over the same period. Greenlip charts show catch as hatched columns, and catch rates as grey balls joined with a grey line.

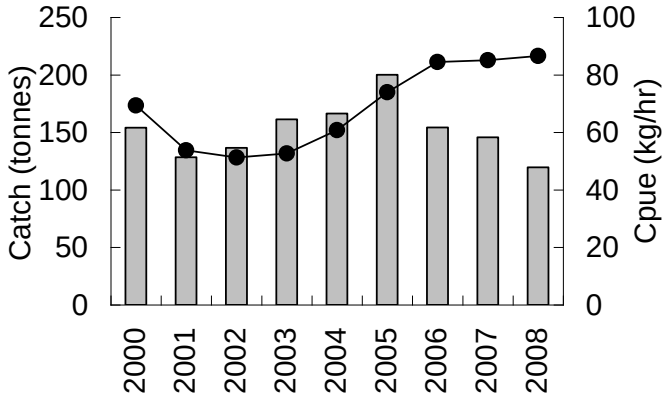


Figure 8. Annual catch (tonnes) and geometric mean catch rates (kg/hour), 2000 - 2008.

Catch rates are expressed as geometric mean catch rates rather than arithmetic means because abalone catch rates do not tend to follow statistically normal distributions and using the geometric mean helps avoid biasing the estimated catch rates for all divers combined. Highly skewed catch-rate distributions, such as those from the Western Zone typically have arithmetic means approximately 10% higher than geometric means. Arithmetic means are also more sensitive to extreme values than geometric means, which, in the context used here, are usually attributable to fleet dynamics, not regular fishing practises.

Catch and effort were not reported by sub-block and zone prior to 2000, and consequently are shown only from that year onwards. Additionally, catch rates trends over short periods (compared with longer periods) are more likely to reflect changes in abundance of abalone and not changes in fishing methods, and catch rates earlier than 2000 are not used in this assessment.

Regional catch-rate distribution:

The distribution of catch rates provides information about how divers are catching abalone that is not explained by the mean (Figure 9). That the distributions are skewed

(not evenly distributed about the category with the highest percentage) implies that fewer divers are achieving high catch rates. Skewness tends to be greatest when abalone abundance is low or has been recently reduced, making high catch rates less common.

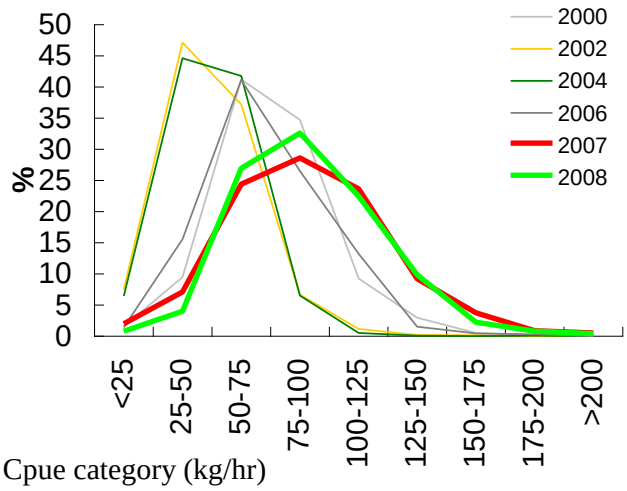


Figure 9. The percentage distribution of catch-rates, 2000 - 2008.

Size-composition charts.

The size-composition of divers' catches is reviewed at sub-block level (Figure 10). At this spatial scale, there is a greater likelihood that the catches come from populations with similar growth characteristics than at larger scales. We are unable to estimate the percentage of catches sampled prior to 2000 because sub-block reporting was not introduced until then. We are able to attribute some sampled catches to sub-blocks in earlier years, because we know the location from where the catches were taken.

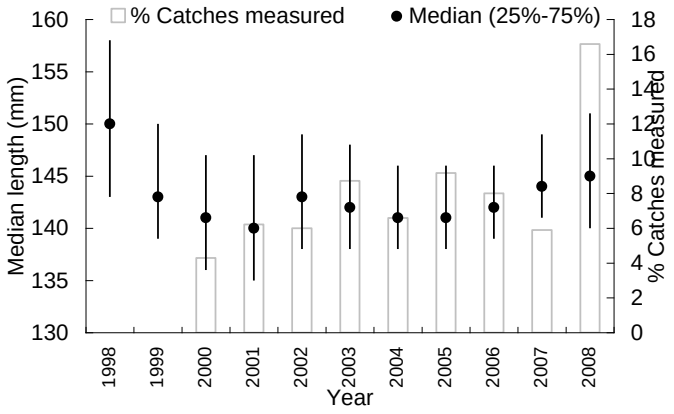


Figure 10. Median length with 25%-75% inter-quartile size range of abalone from commercial catch samples. The vertical columns represent the percentage of catches sampled.

Size-composition charts plot median length (the middle or 50th percentile length if all abalone were sorted from smallest to largest) for the period 1998-2008 (or the period since catches can be attributed to sub-blocks). They also show the size of abalone at the 25th and 75th percentiles *i.e.* the size range of the middle 50% of abalone from the sampled catches.

Appendix 2: Interpreting trends in catch and catch rate, and the size composition of the commercial catch.

The use of catch and catch rates to infer changes in abundance

This assessment is primarily based upon the interpretation of information produced from fishery catch data; both catch distribution and catch rates. It relies upon the assumption that trends in catch-rates reflect changes in abundance of the fishable stock. Despite CPUE being much discredited as an index of abalone abundance (*e.g.* Breen (1992), Prince (1992), Shepherd *et al.* (2001)) it has been used with some success for many years in the Tasmanian fishery. There are several factors that adversely affect the relationship between CPUE and abalone abundance: gregarious behaviour of abalone, serial depletion of local populations constituting the stock, and changes in fishing efficiency. If the effects of the above factors are understood and can be minimized then the reliability of CPUE as an index of abundance can be improved.

Gregarious behaviour

Abalone tend to aggregate in favourable habitat (*e.g.* gutters, sand-edges, shallow margins), and a large proportion of abalone may be found in only a small area of each reef (Prince, 1992). When these aggregations are fished, the remaining abalone tend to form new aggregations (Officer et al., 2000), and thus reefs may become depleted while catch rates are maintained (McShane, 1995; Officer et al., 2000). Similar problems among other commercially fished marine species are well documented (*e.g.* Hilborn and Walters (1992), Rose and Kulka (1999)).

Where abalone abundance is high and abalone are aggregated, catch rates are primarily a function of handling time (the time taken to detach abalone from the reef and transfer them to the boat). As abalone abundance decreases, and aggregations become smaller and further apart, search time increases, and adds significantly to the overall effort required. This makes the relationship between abalone abundance and CPUE non-linear (hyperstable – CPUE remains high even when stock size reduces), and by the time catch rates start to decline rapidly, abalone abundance will already have been greatly reduced (Prince, 1992).

A related problem occurs when divers search for favourable habitats, and the aggregations within them. Time spent searching for aggregations is only weakly related to the number of individuals landed, and catch rates do not necessarily decline at the same rate as the abundance of aggregations (Breen, 1992). Under these circumstances, catch rates are again unreliable, and extra care is needed when attempting to interpret such information. This problem would also occur if divers were searching for areas containing abalone within a specified size range, or where divers were swimming over larger abalone within an area if selecting a particular size range of abalone.

Where abalone abundance is low, a consequence of aggregating behaviour is that the most favourable habitats can accommodate most of the population and the surrounding areas may be relatively sparsely populated. Provided effort is also low (*i.e.* diver visitation rates are low), legal-sized abalone move to the favourable habitat (Officer et al., 2000; Shepherd and Partington, 1995) between fishing events. Experienced divers

can maintain catch rates by fishing the most favourable areas (Shepherd and Partington, 1995), and the CPUE/abundance relationship is again non-linear and hyperstable.

Serial depletion

Serial depletion of reefs occurs when divers progressively reduce stock abundance on individual reefs, and maintain stable catch rates by moving between reefs (Prince and Shepherd, 1992). Reefs are abandoned when divers find it harder to maintain levels of daily catch, and effort is focused on reefs with higher stock levels. When there are many reefs with low levels of abundance in a reporting block, divers can move between reefs, depleting stock levels in each, while producing stable but relatively low levels of annual catch at acceptable catch rates.

If management units are large and catch reporting occurs over large spatial scales, falling catch rates caused by depletion of individual reefs are masked when divers transfer effort to reefs with higher levels of abundance. If catch reporting occurred at the scale of individual reefs, the fall in CPUE that precipitated the divers' movements and the fall in catch indicative of depletion would be detected. In Tasmania, the recently introduced sub-block scale of reporting (Appendix 11) is an improvement, but is still too large to detect such fine scale declines in CPUE.

Regular patterns observed in the spatial distribution of catch from Tasmania's East Coast appear to indicate that provided effort is low enough, stock levels on the reefs first depleted may recover sufficiently to support further fishing, thus developing a cycle of depletion and recovery. Analysis of catch data from a range of reporting blocks has revealed historically low levels of annual catch. Such low catch levels may appear stable in the short term, but have been seen to fall slowly over a period of years, presumably as reefs become less productive (*i.e.* the period between fishing and recovery is greater than the period between fishing events). Examples include Blocks 25, 26, 28, 29 and 30. Catch rates under this scenario typically appear stable, or with improvements in diver efficiency, may even rise slowly.

Change in fishing efficiency

The detection and avoidance of difficulties associated with improvement in fishing efficiency, or effort creep is a continuing problem when catch rates are used as an index of stock biomass or abundance when assessing fisheries. Catch rates (CPUE) and the stock biomass are assumed to be related: CPUE = qB, where q is the catchability coefficient and B is the exploitable biomass. If q increases through time in an unknown manner, through diving operations becoming more efficient, then the relationship between CPUE and biomass becomes altered to an unknown degree and the interpretation of CPUE as a measure of biomass becomes biased high.

One of the features of commercial fisheries is that fishermen almost always find ways to make their operations more efficient, and the abalone fishery has been no exception. Thus, because of improved efficiency, if stock levels are unchanged, more abalone can be collected per unit time now than in the past *i.e.* catchability increases. This leads to a rise in reported catch rates without an associated increase in abalone abundance, or alternatively, it can lead to catch rates appearing to be stable while the stock abundance

is, in fact, declining. Two broad categories of causes of change in fishing efficiency have been identified in the Tasmanian abalone fishery – technological and behavioural.

Technological causes of change in fishing efficiency are usually easy to detect. For example, early in the history of the Tasmanian abalone fishery, divers anchored their boats, and often worked without a deckhand. Later, during the 1970's, the boats carried a deckhand who drove the boat and followed the diver, thus eliminating time spent swimming the catch from the reef to the anchored boat. It was estimated that the catching efficiency of divers doubled between the start of the fishery in the 1960's and 1982 (Harrison, 1983).

Possibly the greatest single improvement occurred during the late 1980's when divers widely adopted the practise of attaching their collecting nets to ropes lowered to them by their deckhands (droplines) and they no longer had to surface to the boat every time they filled their nets. This increased efficiency because:
(a) time spent ascending to the boat, unloading the catch and descending back to the reef was eliminated,
(b) the diver maintained his position on the productive part of the reef,
(c) catch bags could be reduced in size, which meant that divers could swim more easily and with less effort.

However, the increase in efficiency caused by droplines is not constant across all abalone densities. At low levels of abundance, divers may finish swimming over a reef before their net is full, so the method offers little improvement. At the other extreme, when nets are being filled every few minutes because abalone are particularly abundant, the method offers great savings in time *i.e.* the method causes catch rates to change non-linearly with abundance.

More recent technological changes to fishing operations include the increased use of GPS navigation systems, Nitrox breathing gases and diver propulsion vehicles (DPV). The extent of the usage of GPS navigators and associated plotting equipment by abalone divers is unknown, but it apparently has become much more widespread over the last five years. Nitrox gas mixing plants are currently used by only a few divers, but these divers are responsible for landing a large proportion of the catch in the regions where they work. DPVs are also not yet in common usage, but help divers move more quickly between concentrations of abalone, particularly in deeper water.

Changes in fishing efficiency due to behavioural causes, while not as obvious as technological causes, may have a profound effect upon catch rates. Competition between divers for fish or quota, or inducements offered by processors, or management changes, may all improve, or at least alter, the way divers work (Gorfine, 2001). Divers, either individually or as a group may learn to fish an area more effectively (Breen, 1992). Daily catches may increase when divers realise they are catching at a high rate, leading to a correlation between high catch rates and larger catches (Worthington et al., 1998). These types of changes are more difficult to detect and account for than changes in fishing methods.

In Tasmania, the practise of team diving (where two divers share a boat and catch fish on the same quota unit) was legitimised in 2005. Team diving potentially has the effect of reducing diver efficiency, but increasing profitability because of cost-sharing

between the divers. Prior to 2005 team diving was illegal and unreported but allegedly quite common. There is no information to show that the incidence of team diving post-legalisation is different to the former level, but it is potentially a cause of changes to diver efficiency.

Since 2007, divers have reported that the availability of improved forecasting of sea conditions was responsible for effort creep through improved catch rates, because they could choose to fish the West Coast when conditions were optimal. Previously they had travelled to the west when they hoped conditions were favourable, but often were not, and faced with the prospect of returning home with no catch, were obliged to fish in less favourable conditions with a greater likelihood of reduced catch rates.

The most recent Tasmanian study into the effects of effort creep on abalone catch rates was made using catch-effort data collected between 1975 and 2000, from Blocks 13 and 14. Using documented estimates of effort creep as guidelines (Buckworth, 1987; Haddon and Hodgson, 2000; Harrison, 1983), a series of plausible effort creep scenarios was constructed. Extrapolation of Harrison's (1983) estimate of effort creep (approximately 5% p.a.) caused an overall reduction in relative CPUE over the study period *i.e.* by removing the confounding effect caused by improvements in diver efficiency, catch rates were higher in 1975 than they were in 2000 (Tarbath et al., 2001). However, the overall relative trends in catch rate were only slightly altered when using the standardization (Figure 11).

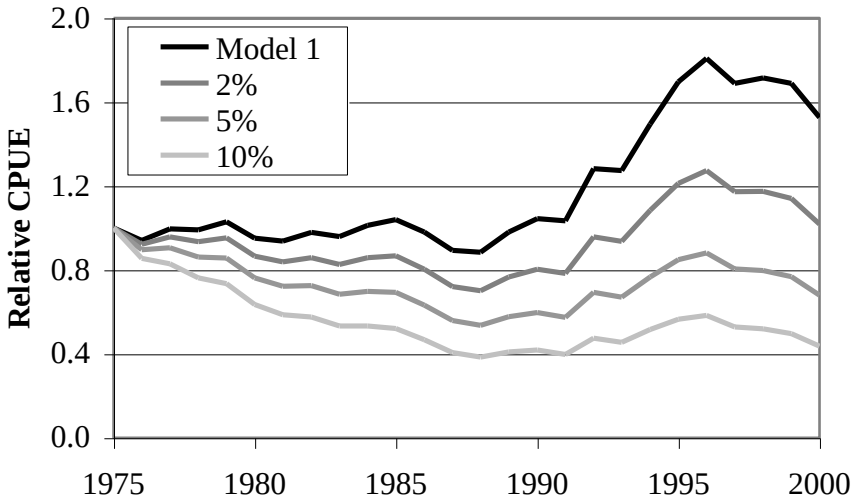


Figure 11. Relative CPUE indices for Block 13, 1975-2000. Model 1 is the raw geometric mean of CPUE. The three effort creep scenarios considered are: (i) 2% per annum; (ii) 5% per annum; and (iii) 10% per annum. All values of CPUE are relative to 1975 (Tarbath et al., 2001).

Improvements in efficiency are extremely difficult to quantify accurately. Without the resources to make an intensive study into historical diving techniques and behaviour (which anyway would have to rely on divers' memories) or alternatively make guesses about how much more efficient current divers have become, we have chosen to limit the comparison of catch rates over a short period during which we assume that divers operated with equal efficiency. This assessment reviews catch-rate trends over the last seven years. (The introduction of sub-blocks and consequent finer scale reporting in 2000 means that most comparisons at a finer geographical scale are currently limited to

a seven-year period.) By reducing the period over which comparisons are made, it is assumed to be more likely that changes due to improved fishing methods or diver behaviour are avoided, and there is more confidence that catch-rate trends represent changes in abundance, not changes in fishing power.

Circumstances when catch rates are reliable indices of abalone abundance

When problems caused by abalone aggregations, serial depletion and improved efficiency are understood and measures are taken to counter their effects, catch rates can reliably reflect abundance. For example, in the NSW blacklip fishery, high visitation and exploitation rates preclude the formation of aggregations of legal-sized abalone, and stocks are uniformly maintained at a low level. A consequence of this is that the recovery-depletion cycle evident in other fisheries is removed. Researchers in NSW have concluded that with the lowered stock abundance catch rates had become a reliable index of abundance (Andrew et al., 1997; Worthington et al., 1998). Similarly, in the more heavily fished parts of Tasmania (*e.g.* the Actaeons) where it is known that diver visitation rates to reefs are high (*i.e.* restrict the formation of aggregations), divers are unable to successively deplete reefs (because all reefs support continuous levels of effort). Provided the effects of effort creep are reduced by limiting the review period to years when diving methodology is unchanged, we can assume that catch-rate trends are indicative of changes in abundance.

These conditions of intense fishing pressure are probably common in parts of the Eastern Zone fishery from where most of the catch is taken, particularly the Actaeons and Storm Bay regions, and the more heavily fished parts of the Northern and Western Zone fisheries in North West Tasmania and the South Coast. However, there are many parts of the Tasmanian fishery where these conditions cannot be met, and assessment of these areas based on catch rates must be viewed with caution. The following cases are discussed:

Previous assessments assumed that abalone abundance was high in parts of the Western Zone (South West and Central West) given the relatively high catch rates reported there. Because diver visitation rates to these areas were relatively low enabling abalone to form aggregations between fishing events, less credence was placed on catch rates as an indication of stock abundance. However, it was previously concluded that stocks levels remained adequate, because catch rates were relatively high compared with other parts of the fishery that were known to be sound. It now appears that along much of the coast line, the population remnants contracted to either deep water or the wash zone, where they could still be caught at high catch rates. The reported decline of stocks and widespread concern among divers who fish in the South West highlights the dangers of relying upon absolute values of catch rates to gauge abundance levels.

Because of past quota reductions, much of the Eastern Zone, particularly the northern part of the East Coast, has been fished at low levels of effort. This means that effort has been not been consistently applied to populations, allowing the formation of aggregations between fishing events, which may span fishing years. In addition, in recent years, catch levels have been dependent upon divers rotating effort and successively depleting reefs on much of the East Coast between Triabunna and Eddystone Point (Blocks 25 – 30). Under these circumstances, the relationship between

abalone abundance and catch rates is almost certainly different than under conditions of constant levels of effort, and catch rate trends should be used with caution.

Much of Tasmania's greenlip fishery is fished under similar circumstances to the East Coast blacklip, reducing the value of catch rates for assessment purposes. However, there are two further problems to consider with the greenlip fishery. Firstly, it is evident that many divers are learning to fish greenlip abalone more efficiently, compounding the difficulty faced in interpreting the abundance/catch-rate relationship. Secondly, each region's greenlip catch is relatively small, with few participating divers. The entry or exit of a diver who catches at different rates from the others can change the region's catch rates (attempts at standardising effort by diver have proved unsuccessful). Throughout southern Australia, fishery managers have a long history of monitoring greenlip fisheries using fishery catch and effort data with a notable lack of success. The Victorian fishery collapsed, and fisheries in South Australia (Shepherd et al., 2001), Western Australia (Hart et al., 1999), and Tasmania (Officer, 1999) have all wiped out greenlip populations because CPUE trends provided inadequate warning of stock depletion. Consequently we have placed less reliance on a CPUE/catch-based assessment in these areas.

Despite the difficulties with interpreting catch-rate information, it is proposed that, when catch rates are examined in combination with trends in the catch itself, along with the median size of captured abalone, some interpretations are more likely than others. The strongest indications of abundance change occur in two situations: (i) when catch rates continue to decline despite a decline in the catch; and (ii) when catch rates increase when catches increase.

Declining catches combined with continuing declines in catch rates could indicate a recruitment decline: despite a reduction in fishing pressure, catch rates continue to decline because there are increasingly fewer recruits each year to the fishery. This is expected to be associated with a decline in the median size of abalone because fishing mortality increases and fewer animals are left to grow to larger sizes.

Catch rates increasing with increasing catches are likely to indicate an increase in fishable biomass. Examples include most of the east, south east and west coast blocks in the early and mid 1990's, and more recently, the Actaeons. It is expected that the median size will eventually increase, though a decrease is possible if the increased catch is due to large numbers of new recruits entering the fishery.

Size composition of the commercial catch

Almost since the inception of the fishery, abalone from divers' catches have been sampled for length measurements to provide information about the condition of stocks. However, because the reporting of catches was at the gross spatial scale of blocks, the samples were of limited value in assessing the impact of fishing on populations. While changes in size structure could be seen, it was never certain whether the changes were due to fishing mortality or because divers re-directed effort between populations with vastly different growth characteristics. In 1998, divers started submitting photographic samples of their catches with details of the location from where the catch was taken, which, given adequate levels of sampling, meant that individual populations could be monitored. Although the photographic program stopped in 2000, in that year the start of

catch reporting by sub-blocks increased the value of length-based monitoring for the stock assessment.

Since 2000, diver's catches from around the State have been routinely sampled by TAFI research staff, mostly at fish processing factories, but occasionally at boat ramps and aboard boats. Most of the sampling has been from catches taken in the south east and east coasts, but catches from the north and west coasts have also been measured. The fish processing factories have included both canners and live-market traders. Catches are selected haphazardly, depending upon the availability of both catches and catch-samplers.

The aim of catch sampling is to provide information about the size-structure of the catch from fished abalone populations, independent of variation caused by a range of confounding effects. For example, divers' catches from the same sub-block on the same day may comprise abalone of widely varying lengths, caused by fishing populations with different growth characteristics. In the south east, the size-structure of catch samples may be influenced by seasonal growth rates, particularly when exploitation rates are low, and consequently samples collected during autumn and winter contain larger abalone than in spring and summer. Market preferences for abalone within a specific size-range will also be reflected in catch samples. There are also other more minor sources of bias relating to measuring errors, stemming from both the diver and the catch sampler.

Sampling involves measuring 100 abalone randomly selected from a diver's catch. Sample design was based upon work done by Andrew and Chen (1997) in the New South Wales abalone fishery. Their strategy was to collect small samples from many catches, rather than large samples from a few catches, increasing the likelihood that the samples better represented the whole commercial catch and hence the populations from which they were taken.

For the purpose of this assessment, samples have been grouped by year and sub-block. Sub-blocks where less than 4% of catches have been sampled during more than two years have usually not been reviewed, because the level of sampling may be inadequate to reflect size-structure of fished populations. We have been unable to obtain adequate numbers of samples from the Northern Zone, the greenlip fishery, the Bass Strait Zone and much of the Western Zone. Landings from motherships are usually not sampled, because they mostly comprise catches from more than one sub-block and more than one day, and it is not possible to identify the sub-block from where the catch came.

The 4% level was chosen arbitrarily, with consideration given to the methods of Andrew and Chen (1997). However, where the number of annual landings is low, much higher percentages of sampling may still be inadequate. For example, during 2003 in the Western Zone sub-block 8A, there were 41 landings. Of these, four were sampled (~10%). The median and inter-quartile length estimates from the samples were larger than both those from earlier years and 2004. One of the four samples was taken from an unusually large catch caught at high catch rates, and it is surmised that, as occasionally happens on the west coast, unusually calm conditions enabled the diver to fish part of a hitherto unexploited population which contained older and larger abalone than normally encountered.

In the Eastern Zone, particularly the south east, the number of landings is much higher and effort is more evenly distributed across populations, thus reducing the effect of unusual catches. The size-composition charts of the south east blocks consistently show similar trends, even those sampled at less than the 4% level. In particular, the median length of 2002 samples in almost all sub-blocks increased, in conjunction with the 4-mm size-limit increase that was applied in that year, regardless of the level of sampling. The relatively high median size of 1998 and 1999 samples and the fall in length since then is also common across sub-blocks where those years were sampled. This trend is consistent with known decreases in the available stock and confirms that the level of sampling is adequate to detect trends. The level of sampling in 1998-1999 can only be guessed at by applying catch numbers from later years, which suggests sampling was below 4% in many sub-blocks. (The level of sampling of pre-2000 catches could not be determined because although the sampled catch locations were known, all other catches were not reported by sub-block.) We conclude that the 4% level of sampling in the Eastern Zone is adequate, and that trends in median and inter-quartile lengths can reflect changes in the fished population size-structure.

Interpreting annual changes in median and inter-quartile lengths

Catch samples show that since 1998, throughout much of the south east there has been a trend of decreasing median size of abalone in commercial catches. Two opposing scenarios are proposed that might explain falling median length in the south east.

If abundance levels fall yet catch levels remain constant (*i.e.* exploitation rates rise), the average period of time between attaining legal size (recruiting) and being caught becomes shorter. Because abalone length is a function of time and growth rate, this means that overall growth is reduced, and the median length of the catch will fall. Under these circumstances, the 75th percentile length (the length which, down to the legal limit, includes 75% of the available legal stock) could also be expected to fall with the median. As long as recruitment levels are unaffected, the 25th percentile length would be expected to remain at similar levels to those seen in previous years. If exploitation rates further increase, then the 25th percentile length would eventually fall. As a further indication of falling abundance a corresponding reduction in catch and catch rate trends would be expected.

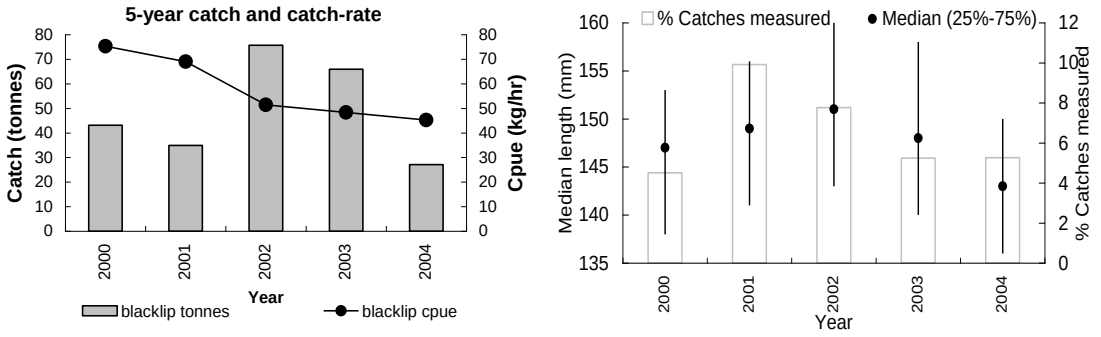


Figure 12. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 13C, 2000-2004.

For example, in sub-block 13C (Whale Head to Fishers Point, Actaeons region) between 2002 and 2004, firstly catch rates and then catches fell, suggesting high

exploitation rates (Figure 12). The median length of landed abalone increased in 2002, when the size limit was raised 4 mm, but has since fallen, again suggesting high exploitation rates. In 2004, the 75th percentile fell sharply, consistent with a fall in the numbers of large abalone landed. In addition, in 2004, the 25th percentile declined suggesting a decline in recruitment. The catch and catch rate trends indicate that abundance here is low. All three indicators suggested unsustainable levels of fishing in 2004 (Figure 12).

The second alternative interpretation of the reduced median length is that abundance of small abalone has increased due to an extraordinarily large influx of recruits. The median and 25th percentile length could be expected to fall, but, unless the fishery was dominated by recruits, the 75th percentile length would be stable or possible increase as exploitation rates fell. Increased levels of catch and catch rate would confirm that abundance had increased. An example of this has occurred in sub-block 20B (Figure 13).

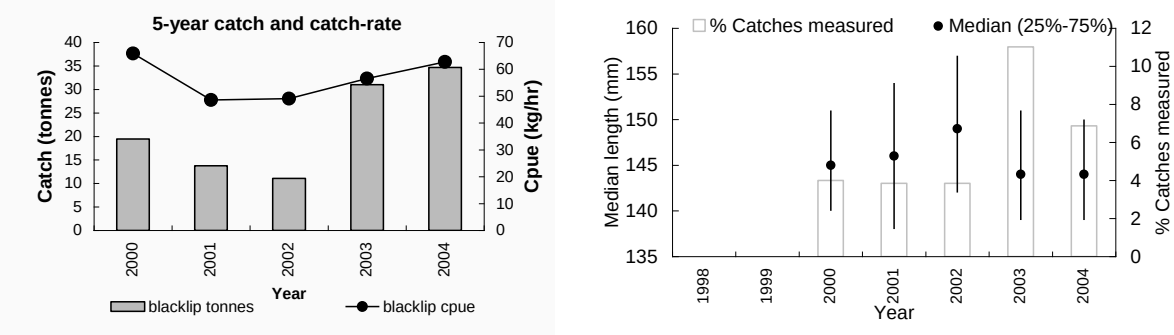


Figure 13. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 20B, 2000-2004.

Increasing or stable median length, in conjunction with increasing catch and catch rates are strong indicators of rising stock levels. Catch rates and levels of catch in sub-block 24B (Maria Island) have started to recover since 2002 (Figure 14). The median length from catches sampled since then is also consistent with stock recovery. The increase in median length associated with the 4-mm increase in size limit in 2002 is again apparent; however, in contrast to sub-block 13C (Figure 12), the size-structure has been maintained, indicating that the levels of fishing pressure currently appear to be sustainable.

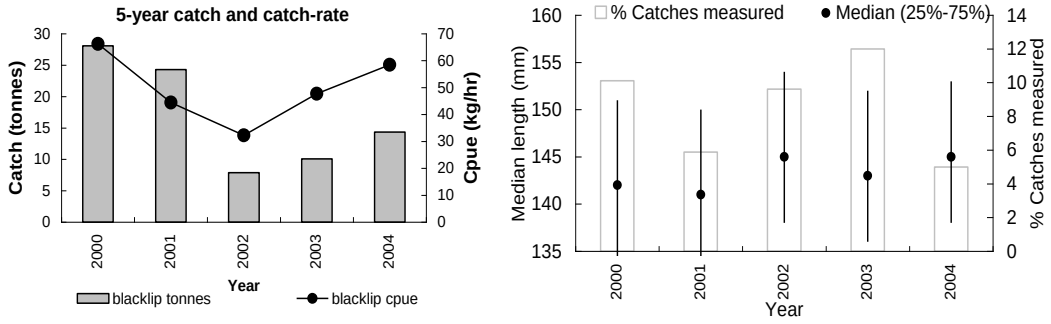


Figure 14. Trends in catch, catch rate and median length (flanked by the 25th and 75th percentile bounds), sub-block 24B, 2000-2004.

Appendix 3: Annual Catches From The Western Zone 1975 - 2008.

Reported annual tonnages of blacklip abalone caught within the statistical blocks and sub-blocks comprising the Western Zone in 2008. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. Because the Western and Eastern Zones were established in 2000, and the Northern Zone in 2001, prior to those years it has not been possible to accurately assign catches to zones in blocks where zone boundaries occur. Consequently, catches in those blocks have been placed in the zone where the majority of catches occurred, so that earlier catches from Blocks 5 and 13 have been placed in the Northern and Eastern Zones respectively.

Year	5	6	7	8	9	10	11	12	13	Total
1975		110	36	42	126	130	191	143		778
1976		63	56	77	252	179	240	153		1020
1977		50	24	22	123	98	153	189		658
1978		79	13	27	115	258	275	208		973
1979		112	19	23	172	166	269	325		1086
1980		196	81	63	316	195	338	351		1539
1981		257	88	87	444	260	417	246		1798
1982		147	34	34	249	100	303	235		1102
1983		231	102	58	199	174	430	242		1435
1984		298	78	38	248	284	681	258		1884
1985		322	99	23	246	140	478	155		1463
1986		213	97	11	133	127	289	193		1064
1987		185	84	44	252	82	339	195		1181
1988		241	53	27	159	124	270	162		1036
1989		192	49	46	120	109	212	144		873
1990		197	56	21	95	80	232	125		807
1991		169	54	30	102	106	219	140		819
1992		235	70	36	91	95	266	159		952
1993		154	64	38	110	65	197	177		805
1994		79	33	38	77	60	202	160		649
1995		112	30	17	44	68	186	182		638
1996		103	67	13	59	75	145	148		611
1997		98	75	28	140	66	224	227		858
1998		126	51	27	78	47	163	192		684
1999		149	60	24	115	58	220	251		878
2000		183	61	23	205	148	326	282	54	1281
2001	0	210	32	15	186	152	312	290	43	1241
2002	2	173	51	17	174	143	360	236	93	1248
2003	0	97	104	27	142	239	345	229	67	1251
2004	3	88	89	22	130	181	374	250	96	1234
2005	6	95	110	26	92	149	389	311	65	1242
2006	4	109	76	6	142	198	384	228	89	1236
2007	0	76	39	18	178	231	354	267	68	1231
2008	0	105	51	9	156	178	345	305	79	1229
average	2	155	61	31	161	140	298	216	73	1082

Appendix 4: Annual Catches From The Eastern Zone 1975 - 2008.

Reported annual tonnages of blacklip abalone caught within statistical blocks and sub-blocks comprising the Eastern Zone in 2008. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. Because the Western and Eastern Zones were not established until 2000, and the Northern Zone until 2001, prior to those years it has not been possible to accurately assign catches to zones in blocks where zone boundaries occur (Blocks 13 and 31). Consequently, catches in those blocks have been placed in the Eastern Zone, because the majority of later catches occurred there. This means that the average catch for these two blocks is probably overestimated.

Year	13	14	15	16	17	19	20	21	22	23	24	25	26	27	28	29	30	31	Total
1975	247	111	10	47	11	0	16	27	49	74	15	16	5	44	69	16	44	32	835
1976	208	156	0	64	36	1	18	25	45	56	18	12	9	40	72	9	37	50	857
1977	245	232	2	190	11	1	23	35	37	53	11	10	8	55	90	22	119	54	1196
1978	322	218	6	119	24	1	32	65	60	88	22	13	11	93	87	25	137	105	1431
1979	374	251	8	148	25	2	51	52	43	30	9	23	7	80	52	12	105	60	1332
1980	272	255	7	145	30	1	33	30	42	46	158	34	7	108	91	27	148	105	1538
1981	254	299	18	127	48	4	45	69	35	77	137	19	15	68	154	22	146	52	1586
1982	337	218	15	147	24	3	36	62	63	49	97	20	9	89	100	32	170	48	1519
1983	250	300	10	189	28	3	43	63	54	92	99	31	14	99	103	65	296	90	1828
1984	318	297	18	166	35	5	47	70	73	61	109	10	11	106	112	52	148	76	1714
1985	256	262	4	89	83	11	68	80	43	44	120	20	17	86	71	5	84	171	1515
1986	220	262	22	82	93	4	65	66	70	56	88	12	20	50	58	14	124	164	1472
1987	224	229	7	47	80	1	43	44	32	34	66	12	8	76	45	11	67	54	1082
1988	219	258	6	76	57	4	62	44	43	34	79	10	6	65	52	16	93	90	1214
1989	156	172	2	56	43	2	61	42	22	16	34	7	8	41	31	11	39	27	770
1990	132	193	4	76	29	3	33	51	40	36	61	1	2	61	77	21	54	22	897
1991	127	207	2	60	37	3	53	50	47	31	67	2	9	64	66	12	30	21	890
1992	140	106	3	28	20	2	51	43	49	23	67	1	1	67	45	7	10	13	676
1993	257	116	4	100	40	1	59	78	48	24	73	1	1	86	39	8	15	15	964
1994	295	139	10	114	46	1	109	80	55	16	53	0	3	103	24	8	11	21	1088
1995	310	247	1	100	35	1	95	74	34	19	38	0	1	81	18	6	10	26	1097
1996	391	195	0	78	18	3	71	55	44	28	67	3	6	89	39	11	28	20	1147
1997	471	137	0	64	25	2	79	49	47	32	106	1	13	190	32	32	23	33	1336
1998	470	108	1	116	23	2	85	64	63	44	160	2	25	180	77	31	10	15	1476
1999	491	66	2	113	35	6	102	72	50	53	143	0	9	95	60	26	11	39	1374
2000	381	98	2	71	29	4	62	60	69	44	104	1	8	101	16	21	10	90	1171
2001	324	157	3	108	20	2	56	50	40	24	111	1	14	68	9	27	13	78	1092
2002	296	101	1	72	16	1	62	58	46	15	46	0	2	53	7	15	12	44	847
2003	291	116	2	60	17	1	88	54	35	21	51	0	3	50	8	19	3	27	848
2004	221	104	7	50	20	2	92	52	35	19	51	1	1	44	11	24	6	22	761
2005	181	90	8	56	20	3	116	62	36	18	66	0	0	43	13	36	7	15	770
2006	184	84	3	67	13	2	73	66	71	23	88	1	1	40	10	41	0	7	773
2007	255	70	0	56	8	6	68	63	61	14	59	0	1	55	11	32	0	4	766
2008	340	56	1	64	8	0	50	61	56	11	68	0	1	48	6	28	0	10	807
average	278	174	6	93	32	3	60	56	48	38	75	8	8	77	52	22	59	50	1138

Appendix 5: Annual Catches From The Northern Zone 1975 - 2008.

Reported annual tonnages of blacklip abalone caught within statistical blocks comprising the Northern Zone in 2008. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. There are no records for the Northern Zone part of Block 31 before that zone was created in 2001.

Year	31	39	40	32	33	34	35	36	38	47	48	49	5	1	2	3	4	Total
1975		2	1	1	10	1	7	7	2	1	12	9	38	32	1	27	15	167
1976		5	0	0	5	0	1	1	0	1	12	33	46	39	0	51	8	203
1977		6	2	6	11	0	0	3	2	0	8	17	51	17	1	87	8	218
1978		8	2	1	5	2	6	5	4	3	10	11	65	21	3	55	25	225
1979		6	1	2	9	0	0	2	2	0	27	7	85	24	2	10	9	187
1980		3	1	2	6	1	1	2	0	0	10	1	92	51	3	33	3	209
1981		6	2	1	6	1	1	0	0	3	33	10	120	19	8	32	9	251
1982		5	2	0	6	1	0	2	4	1	45	7	121	22	9	27	13	266
1983		7	4	0	3	0	1	5	3	9	45	19	228	22	2	31	52	431
1984		6	3	0	7	0	1	2	1	4	80	44	312	10	1	33	55	560
1985		5	1	3	6	1	2	1	0	4	48	50	319	43	0	26	11	522
1986		10	5	0	9	2	3	2	1	15	85	97	267	35	4	24	13	573
1987		6	1	0	7	0	2	1	1	18	58	67	198	44	62	24	54	543
1988		3	1	0	11	1	1	0	0	18	30	38	165	29	16	21	60	393
1989		1	28	0	3	0	0	0	0	14	15	24	88	14	7	10	5	210
1990		0	0	0	1	0	0	1	0	6	14	20	82	11	10	9	11	166
1991		1	0	0	2	0	0	0	0	8	12	10	97	6	7	14	26	185
1992		4	0	0	2	0	0	0	0	3	10	11	76	2	3	9	8	129
1993		0	0	0	3	0	0	0	0	1	7	7	65	8	3	8	9	111
1994		0	0	0	3	0	0	0	0	0	7	12	49	15	2	4	1	94
1995		0	0	0	0	0	0	0	0	0	6	2	62	11	3	1	8	95
1996		0	0	0	0	0	0	0	0	0	4	0	63	7	2	1	2	80
1997		1	0	0	0	0	0	0	0	0	6	2	56	10	1	10	6	92
1998		0	1	0	2	0	0	0	0	0	7	3	61	3	1	0	2	79
1999		5	0	0	4	0	0	0	1	0	14	4	57	5	1	6	6	103
2000		5	2	1	5	0	0	0	0	0	12	25	45	0	0	9	10	114
2001	12	11	3	5	10	1	0	0	3	0	17	72	117	2	1	12	12	279
2002	30	4	3	1	11	1	0	0	2	0	12	48	103	10	2	35	16	277
2003	7	8	1	0	5	0	0	0	2	0	10	76	73	25	1	61	10	279
2004	14	6	1	0	3	0	0	0	1	0	6	62	55	10	0	85	34	277
2005	11	2	0	0	7	0	0	0	2	0	6	54	73	15	2	92	18	282
2006	16	4	0	0	11	0	0	0	10	0	5	57	96	11	3	57	8	279
2007	55	11	0	0	2	0	3	0	0	0	6	59	89	6	0	47	3	280
2008	29	5	0	1	5	0	0	0	6	0	7	74	163	5	0	24	10	329
average	22	4	2	1	5	0	1	1	1	3	20	30	108	17	5	29	16	250

Appendix 6: Annual Catches From The Greenlip Fishery 1975 - 2008.

Reported annual tonnages of greenlip abalone caught within the statistical blocks comprising the Greenlip fishery in 2008. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights.

Year	31	39	40	32	33	34	35	36	37	38	47	48	49	5	1	2	3	4	Total
1975	7	3	4	3	17	14	49	69	14	11	0	7	2	8	0	3	0	1	213
1976	14	2	9	1	26	11	55	49	2	10	0	8	6	14	0	0	0	0	210
1977	6	8	4	6	23	21	50	24	1	22	0	40	2	17	0	0	0	0	223
1978	8	1	2	4	12	17	51	38	7	17	1	13	3	12	1	3	0	2	191
1979	11	6	2	10	21	8	46	15	4	4	0	11	0	8	0	0	0	0	146
1980	4	3	5	7	15	3	29	13	4	4	0	6	0	5	0	3	0	0	100
1981	6	4	2	12	17	17	34	10	9	0	3	12	1	9	0	12	0	4	153
1982	27	1	3	4	13	14	29	7	9	9	2	7	0	2	0	14	0	2	141
1983	23	2	0	4	21	8	34	9	4	8	14	40	11	9	0	9	0	5	201
1984	50	8	4	9	27	15	56	7	6	0	52	60	2	11	0	7	1	5	320
1985	53	5	4	9	20	15	42	4	7	7	12	36	3	3	0	1	0	1	222
1986	39	8	7	4	14	7	36	2	10	0	57	35	14	5	1	8	0	3	251
1987	32	12	1	8	20	10	30	8	10	7	37	33	3	8	13	125	5	69	431
1988	35	2	1	8	19	5	28	13	6	0	35	21	4	10	3	33	2	12	240
1989	22	5	2	4	16	2	22	10	3	0	20	27	4	6	1	70	3	10	227
1990	23	7	0	4	9	3	25	6	1	3	21	27	11	11	2	49	3	13	218
1991	20	6	0	4	7	2	31	6	3	0	13	32	6	12	2	29	3	16	191
1992	15	9	0	3	4	1	18	6	2	0	4	14	2	4	3	21	0	8	115
1993	9	2	0	1	4	2	16	8	3	0	2	26	4	2	2	18	0	9	110
1994	12	1	0	3	8	1	17	5	3	0	3	48	3	10	4	25	0	7	149
1995	24	6	2	2	7	3	15	3	3	9	5	23	5	8	14	9	0	12	149
1996	11	13	2	3	13	4	17	2	8	12	1	15	0	3	37	33	1	13	190
1997	17	22	1	8	13	1	12	4	11	15	1	28	3	6	35	33	0	6	215
1998	4	17	24	5	5	1	23	1	2	2	2	43	8	14	31	34	0	5	222
1999	6	2	4	2	17	1	15	1	2	4	0	20	1	10	21	25	1	10	142
2000	12	15	12	8	11	2	14	3	2	2	0	24	12	13	2	4	1	3	140
2001	7	20	4	14	14	2	9	3	1	0	0	35	9	3	8	8	1	2	140
2002	17	12	2	4	16	2	8	2	2	9	0	27	7	7	11	6	1	7	140
2003	18	16	1	5	16	1	10	2	1	3	0	14	10	10	14	11	3	4	140
2004	9	22	0	4	4	1	13	3	1	11	0	14	6	10	14	10	4	3	128
2005	6	13	1	2	12	1	10	3	1	15	0	19	1	12	16	7	4	3	123
2006	3	13	0	5	5	1	11	1	4	13	0	29	2	8	11	10	2	5	123
2007	20	14	0	3	6	1	13	2	0	5	0	21	3	9	10	7	3	6	124
2008	13	12	0	3	6	1	12	4	3	5	0	33	3	5	4	10	1	5	121
average	17	8	3	5	14	6	26	10	4	6	8	25	4	8	8	19	1	7	181

Appendix 7: Annual Catches From The Bass Strait Zone 1975 - 2008.

Reported annual tonnages of blacklip abalone caught within statistical blocks comprising the Bass Strait Zone in 2008. These tonnages are derived from estimated weights, which do not correspond exactly with landed weights. The Bass Strait blacklip fishery was closed in 2008, and no catches were reported.

Year	37	41	42	43	44	45	46	50	51	52	53	54	55	56	57	Total
1975	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1976	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
1977	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1978	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	1
1979	1	0	0	0	0	0	3	0	0	0	0	0	0	0	0	4
1980	1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1981	2	0	0	1	0	0	0	0	0	0	0	0	0	0	0	3
1982	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1983	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1984	0	0	0	1	0	0	3	0	0	0	0	0	0	0	0	5
1985	0	2	0	2	0	0	0	0	0	0	0	0	0	0	0	4
1986	1	1	0	4	0	0	1	0	0	0	0	0	0	0	0	8
1987	2	2	0	8	1	0	0	0	0	0	0	0	0	0	0	14
1988	0	0	0	1	1	0	1	0	0	0	0	0	0	0	0	4
1989	8	19	11	34	1	5	14	1	24	0	41	4	0	6	0	168
1990	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
1991	17	0	0	0	0	0	0	0	14	5	28	1	0	17	15	96
1992	0	0	0	0	0	0	0	1	0	0	0	0	0	0	0	1
1993	19	0	0	0	0	0	0	0	21	4	37	1	0	6	8	95
1994	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1995	52	0	0	0	0	0	0	1	46	2	44	0	0	0	5	149
1996	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1997	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1998	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1999	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2000	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2001	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2	2
2002	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
2003	6	1	2	2	0	0	2	0	7	2	36	2	0	7	2	70
2004	3	4	4	1	0	0	1	0	1	0	42	5	2	7	0	70
2005	6	4	1	2	0	0	0	0	8	0	35	5	3	3	0	69
2006	20	1	4	5	0	0	5	0	3	0	24	5	2	1	1	70
2007	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2008	21	1	2	5	1	1	3	0	1	0	27	0	0	6	0	67
average	5	1	1	2	0	0	1	0	4	0	9	1	0	2	1	27

Appendix 8: Catch/effort data extract query.

Catch/effort data from divers' catch dockets were provided by DPIW, with tables updated weekly and stored in an Oracle database at the University of Tasmania. The following SQL query was used to extract catch records from the Oracle database:

```
SELECT DISTINCT
     d.docket_number docket
,    f.fishing_date day
,    EXTRACT(month FROM f.fishing_date) month
,    EXTRACT(year FROM f.fishing_date) year
,    UPPER(n3.last_name)||', '
||REPLACE( TRANSLATE(INITCAP(n3.first_names),
'abcdefghijklmnopqrstuvwxyz','##########################'),'#','')
diver_name
,    SUBSTR(d.zone_fishery_code, 3, 1) zone
,    CASE
          WHEN f.block_code BETWEEN 'AB13C' AND 'AB14B' THEN 'ACT'
          WHEN f.block_code BETWEEN 'AB14C' AND 'AB16D' THEN 'BRUNY'
          WHEN f.block_code BETWEEN 'AB17A' AND 'AB21C' THEN 'STMBY'
          WHEN f.block_code BETWEEN 'AB22A' AND 'AB31A' THEN 'EC'
          WHEN f.block_code BETWEEN 'AB32A' AND 'AB38C' THEN 'FG'
          WHEN f.block_code BETWEEN 'AB39A' AND 'AB40C' THEN 'NE'
          WHEN f.block_code BETWEEN 'AB41' AND 'AB46' THEN 'CN'
          WHEN f.block_code BETWEEN 'AB47A' AND 'AB49C' THEN 'NW'
          WHEN f.block_code BETWEEN 'AB01A' AND 'AB04C' THEN 'KI'
          WHEN f.block_code BETWEEN 'AB05A' AND 'AB06D' THEN 'NW'
          WHEN f.block_code BETWEEN 'AB07A' AND 'AB09C' THEN 'CW'
          WHEN f.block_code BETWEEN 'AB10A' AND 'AB12A' THEN 'SW'
          WHEN f.block_code BETWEEN 'AB12B' AND 'AB13B' THEN 'SC'
          WHEN f.block_code BETWEEN 'AB50' AND 'AB57' THEN 'BS'
          WHEN (f.block_code = 'AB31B' AND d.zone_fishery_code =
'AQE') THEN 'EC' ELSE 'NE'
     END region
,    SUBSTR(f.block_code,1,4) blok
,    f.block_code sub_block
,    ROUND(f.blacklip_estimated_weight,0) blips
,    ROUND(f.greenlip_estimated_weight,0) glips
,    NVL(dive_time_1,0) + NVL(dive_time_2,0) + NVL(dive_time_3,0)
total_time
FROM qms.abalone_fishing_details f
,    qms.quota_dockets d
,    lmm.clients n3
WHERE f.fishing_date BETWEEN '01-JAN-08' AND '31-DEC-08'
     AND d.qudo_id = f.qudo_id
     AND n3.client_id = d.docket_signatory_id
ORDER BY f.fishing_date  asc
```

Appendix 9: Treatment of errors in catch data in 2008.

Ongoing review of catch records in the TAFI historical catch and effort database found an error. In the Eastern Zone, in Block 31 in 2001, catches were previously understated by 12t, so that the corrected total is now 78t.

Appendix 10: History of Management Changes

This history has been compiled from a number of sources, principal among which has been DPIW's Abalone Management Plans.

1962	Minimum size limit (MSL) of 5 inches (127 mm) minimum shell diameter introduced.
1964	MSL increased to 6 inches (152 mm).
1965	MSL reduced to 5 inches. Introduction of commercial abalone diving licenses. All abalone to be landed live (no processing at sea). Skippers of boats engaged in abalone fishing required to lodge monthly fish returns as part of their license conditions.
1966	Abalone processing factories required to record the number of persons from whom abalone were bought.
1967	Abalone divers required to carry a measuring device to measure the abalone before taking them. Special penalty introduced for possession of undersized abalone at $1 per fish. Abalone to be sold in live condition to registered processors only.
1968	Abalone catch returns were introduced. These recorded daily catches and effort by reporting block, and were lodged monthly by the skipper (not necessarily a diver) of an abalone fishing vessel. More than one diver's catch could be reported on a return. These returns replaced the general fish return on which earlier catches were reported.
1969	License limitation introduced. Rapid expansion of the fishery led to this first attempt to control effort. Only divers fishing the previous year were licensed to fish in 1969. This figure (120 divers) was maintained in subsequent years.
1971	Only licensed divers allowed to dive from a boat engaged in abalone fishing.
1972	License transfer from a retiring diver to his nominee allowable on grounds of health problems. Annual license fees calculated as 1.5% of the mean of the previous three years value of annual production. An additional five licenses were issued to divers living in the Furneaux Group. These divers were restricted to fishing the Furneaux Group, but the other 120 divers were not prevented from fishing there. Penalties for breaches of regulations in relation to abalone fishing increased. Permit to transfer licenses between divers revoked.
1974	License transfer from a retiring diver to his nominee permitted.

	Computerised catch records started from July 1974.
1979	Penalties for breaches of regulations in relation to abalone fishing increased, with special penalties rising to $2 per fish. Identification cards for divers introduced.
1982	Penalties for breaches of regulations in relation to abalone fishing increased, with special penalties rising to $10 per fish. Catch restricted by marketing crisis: processors limit divers to 24 tonnes pa.
1983	Penalties for breaches of regulations in relation to abalone fishing increased. Easing of market difficulties sees lifting of processor applied catch restrictions.
1985	Individual transferable quota (ITQ) and a total allowable catch (TAC) were introduced. Each of the 120 general license divers were allocated 28 units of quota, the Furneaux Group divers 20 units: therefore there were 3460 units. For 1985, the quota unit was set at 1100 kg *i.e.* the TAC was 3806 tonnes. – This amount was derived from an estimate of average catches, with a 10% bonus granted by the Minister to compensate for any financial difficulties caused by the new system. License fees were increased to 2.5% of the value of the annual landed catch, for each quota unit held. Quota unit transfers between Furneaux divers and non-Furneaux divers were prohibited. The 120 Tasmanian mainland divers were prohibited from diving in the Furneaux group. Divers were required to own at least 16 units, but could accumulate no more than 80. The catch (kg) per quota unit was determined by the Liaison Committee based upon advice from the government researchers. Catch dockets recording the catch weight landed by individual divers were introduced.
1986	Annual license fees set at 5% of value of annual landed catch. The catch per ITQ was reduced to 1000 kg (9% reduction) *i.e.* TAC was 3460 tonnes.
1987	MSL increased to 132 mm from 127 mm. The catch per ITQ was reduced to 950 kg (5% reduction) *i.e.* TAC was 3287 tonnes.
1988	The catch per ITQ was reduced to 855 kg (5% reduction) *i.e.* TAC was 2958.3 tonnes. The minimum legal weight for abalone meats was set at 90 g.
1989	The catch per ITQ was reduced to 600 kg (30% reduction) *i.e.* TAC was 2076

	tonnes. A fishery for abalone in Bass Strait was held in April, with a MSL of 110 mm and a maximum size limit of 132 mm. Each diver was limited to 2.4 tonnes, with 198 tonnes caught. The fishery was free of fees, and while only licensed abalone divers could participate, was held to be distinct from the Tasmanian abalone fishery (hence the maximum size limit). The minimum meat weight regulation of 90g was amended to apply only to blacklip abalone.
1990	MSL for blacklip abalone on south and west coasts between the Wild Wave River (north of Sandy Cape) and Whale Head increased to 140 mm. MSL for greenlip in Furneaux Group waters increased to 140 mm. Furneaux Group boundary removed. The Furneaux Group divers were issued with an extra 8 units each, which could only be fished by the divers themselves and were not transferable. This increased the number of units in the fishery to 3500, and the TAC to 2100 tonnes.
1991	A fishery for abalone in Bass Strait was held in May, with a MSL of 118 mm. The TAC was 110 tonnes, with a fee of $1.40 per kg of quota. The license system was restructured: the diving entitlement was uncoupled from the entitlement to hold quota units and the lower and upper limits on the amount of units held was abolished.
1992	Minimum meat weight for greenlip was set at 70 g. Compliance catch database (SEALSPROD) that enabled auditing of catch from vessel to factory introduced by DPIF.
1993	A fishery for abalone in Bass Strait was held in May and June, with a MSL of 110 mm. The TAC was 100 tonnes, with a fee of $5.00 per kg of quota. Minimum meat weight regulation amended to 90g for all abalone other than greenlip. Penalties reviewed and significantly increased, with the option of prison terms for serious and repeat offenders. Special penalties increased to $50 per fish.
1994	Quota owners were given the choice of continuing with their annual abalone licenses or entering into a Deed of Agreement that applied for 10 years with the right of renewal for perpetuity. 90% of owners chose the Deed of Agreement. The Deed of Agreement set a fee structure that included both management costs and return to the community, based upon an increasing (but non-linear) proportion of beach price. At $6/kg, no fees were payable, at $35/kg fees were 10% at and at $200/kg, fees were 33% of beach price.
1995	A fishery for abalone in Bass Strait was held in May and June, with a MSL of 110 mm. Only 12 commercial divers (*i.e.* non-abalone) participated. While the TAC was 100 tonnes, only 21 tonnes was taken. The fee was $10.00 per kg of quota.

	Another Bass Strait fishery was held in November, with both abalone and commercial divers participating. The MSL was 100 mm, and the TAC was set at 140 tonnes, with a fee of $10/kg. Only 106 tonnes was taken before the fishery was closed. It was maintained by divers that a very high proportion of the fishable biomass had been taken, and that continuing the fishery could affect the sustainability of stocks.
1996	The *Living Marine Resources Management Act 1995* was introduced. Trigger points were introduced by DPIF to initiate a management response if catch and catch rates changed by a pre-determined quantity with respect to those from two earlier reference periods.
1997	The TAC was increased to 2520 tonnes (720 kg per quota unit). Difference in beach price between east coast and west coast blacklip first appears – is initially $2.00.
1998	The first abalone Fishery Management Plan was introduced. Among changes that it introduced were catch monitoring, which included: 1. Pre-fishing reporting by divers, 2. Post-fishing reporting of catch by divers and processors, 3. Processors required to maintain a daily balance of stock in, stock out and stock on hand, 4. Processors to report prior to movement of stock out and on receipt of stock, 5. Reports to be made by telephone, where information was immediately available to Compliance Audit Unit and Tasmania Police. For several years, greenlip abalone had attracted premium beach prices, causing a diversion of effort to that species. To enhance protection, a number of management changes were made: • For management purposes, the greenlip fishery was subdivided into two regions: the Furneaux Group and the remainder (North West, North East and King Island) • MSL was raised to 140 mm state-wide (except the North West, which was left at 132 mm), • The annual catch for the Furneaux Group was capped at 42t based on estimates of sustainable yield. This cap was managed monthly, so that where more than one twelfth of the annual cap (3.5 t) was taken in any month, the Minister could close the fishery until the next month. Within the Furneaux Group, several other rules were introduced to reduce effort: • Divers could only work two days per week. Originally, the days were fixed, but because this forced divers to work in often hazardous conditions, divers were allowed to nominate which two days they could work. • A 200 kg/day bag limit was introduced, as was a 200 kg/day landing limit. This effectively meant that catch was not held on motherships overnight. • These rules were repealed in 1999.

	• The greenlip catch from the remainder of the State was to be limited to 106 tonnes. • Because the Department was unable to monitor catch closely enough, the monthly Furneaux Group catch usually overran its limit, and the fishery there was closed in August when the regional cap was met. The greenlip cap in the rest of the State was also overrun. Vessels over 10 m landing abalone at Smithton or Stanley had to make a prior report to the CAU reporting service so that Tasmania Police could inspect their catch. Fixed trigger points were abandoned as an assessment strategy as rising catch and catch rates indiscriminately fired triggers. Assessments have since used catch and catch rate trends to monitor stock levels. A new compliance catch database (LMM/QMS) introduced by DPIWE
1999	MSL for greenlip raised to 140 mm in North West, and 150 mm for the remainder. This applied to the commercial fishery only, the MSL for recreational fishers remaining at 140 mm. The greenlip fishery was divided into east (Furneaux Group and North East) and west (King Island and North West) with quarterly caps of 17 tonnes and 20 tonnes respectively. Overrun of caps led to a closure of the greenlip fishery in October. Within the Furneaux Group, Block 35 was closed to fishing between 1 October and 31 March to protect spawning abalone.
2000	The blacklip fishery was divided into two East and West management zones with boundaries at Whale Head and Port Sorell. The greenlip fishery was managed separately. Eastern blacklip units were set at 340 kg (TAC 1190t), Western units at 400 kg (1400t) and greenlip units at 40 kg (140t), with a TAC for the whole fishery of 2730 tonnes. Size limits for blacklip abalone remained unchanged. The zone boundaries meant that the Western Zone had a size limit of 140 mm from Whale Head to the Wild Wave River and 132 mm from there to Port Sorell. Following egg-per-recruit studies by researchers, MSL for King Island greenlip was raised to 155 mm, 140 mm for North West and 145 for both the North East and the Furneaux Group. The Block 35 (Franklin Sound - Furneaux Group) greenlip catch was capped at 20 tonnes. Catch were reported on a smaller spatial scale with the introduction of sub-blocks state-wide. Owners of fishing license (abalone dive) were allowed to hold more than one license and allow others to dive those licenses as supervisors.
2001	The Northern Zone (between Arthur River in the west and Musselroe Point in the east) for blacklip abalone was established, with a MSL of 127 mm except between Woolnorth Point and the Arthur River, where 132 mm prevailed. Catch per unit was 80 kg, with a TAC of 280t. Because the Northern Zone

	covered coast that was previously included in the two other blacklip zones, catch for those zones was proportionally reduced, with a further allowance for declining Eastern Zone stocks. The TAC for the West was set at 1260t (360kg/unit), and the East at 1120t (320kg/unit). The greenlip TAC remained at 140 tonnes, so production from the entire fishery was 2800t, or 800kg/unit. In association with establishment of Northern Zone, research monitoring areas were set aside at the Inner Sister, Swan Island, Waterwitch Reef, and the Doughboys. MSL's for recreational divers were changed to 132 mm for blacklip state-wide, and 145 mm for greenlip in all areas except the North West, which remained at 140 mm. The regional catch for the greenlip fishery was limited in three of the main regions. The North West catch was capped at 40t, the North East at 30t, while the Furneaux Group catch remained fixed at 42t. Catch from King Island and the Bass Strait islands (Kent, Curtis, Hogan Groups) was not capped.
2002	MSL for Eastern Zone was increased to 136 mm. MSL for greenlip on King Island was reduced to 150 mm. MSL for greenlip in the North West was increased to 145 mm. Eastern Zone TAC reduced to 857.5t (245kg/unit). Western Zone TAC remained 1260t (360kg/unit) Northern Zone TAC remained 280t (80kg/unit) Greenlip TAC remained 140t (40kg/unit) Production for the whole fishery was set at 2537.5t (725kg/unit). Catch from the Actaeons (sub-blocks 13C, D and E) was capped at 350t, managed firstly as a half-yearly cap, then quarterly. The fishery there was closed in September and then mid-October when those caps were reached.
2003	A Bass Strait blacklip zone (TAC 70 tonnes (20kg/unit), MSL of 114 mm) was created within the Northern Zone in central Bass Strait and part of the Furneaux Group. Its purpose was to enable the catching of abalone smaller than allowed by the Northern Zone size limit. The Bass Strait Boundaries were set at Cowrie Point in the west and Anderson Bay in the east. The Flinders Island boundaries were on an unnamed point north of Settlement Point on the western side of the island (40°00'36.32") and Foochow Inlet on the east. Eastern Zone TAC remained 857.5t (245kg/unit). Western Zone TAC remained 1260t (360kg/unit) Northern Zone TAC remained 280t (80kg/unit) Greenlip TAC remained 140t (40kg/unit) Bass Strait Zone TAC set at 70t (20kg/unit) Fishery production was set at 2607.5t (745kg/unit) state-wide.

	Blacklip catch from Block 5 (Northern Zone) was capped at 100t. MSL for Western Zone between the Wild Wave River and Arthur River was increased to 136mm from 132mm. Abalone taken from Western Zone subject to upper size limit of 160 mm by canners and live market buyers. Note that this was not rigidly enforced and market sampling showed most samples contained many abalone over this size.
2004	Eastern Zone TAC reduced to 770t (220kg/unit) Western Zone TAC remained 1260t (360kg/unit) Northern Zone TAC remained 280t (80kg/unit) Greenlip TAC reduced to 129.5t (37kg/unit) Bass Strait Zone TAC remained 70t (20kg/unit) Fishery production was set at 2509.5t (717kg/unit) state-wide. The greenlip TAC reduction affected the North West only, where the annual cap was reduced by 10t to 30t. October-March closure for Franklin Sound greenlip fishery abolished. Block 35 cap reduced from 20t to 15t.
2005	Eastern Zone TAC remained 770t (220kg/unit) Western Zone TAC remained 1260t (360kg/unit) Northern Zone TAC remained 280t (80kg/unit) Greenlip TAC reduced to 122.5t (35kg/unit) Bass Strait Zone TAC remained 70t (20kg/unit) Fishery production was set at 2502.5t (715kg/unit) state-wide. The greenlip TAC reduction affected the North East only, where the annual cap was reduced by 7t to 23t. Team diving (sharing catch from one quota unit by two divers) was introduced to legitimise the practise of divers catching abalone for others when they held no quota to which their catch could be assigned. Team dive dockets were submitted by teams, but not computerised. High grading (discarding large abalone in the catch from the deck) prohibited. Caufing prohibited. Introduction of cancellation reports where a prior reported trip is cancelled. Introduction of single (blacklip) zone fishing provisions. Overcatch provisions introduced to cover unintentional underestimation of catch weight. In Victoria in December, ganglioneuritis detected on two land-based (Portland and Port Fairy) and two offshore (Westernport) aquaculture sites.

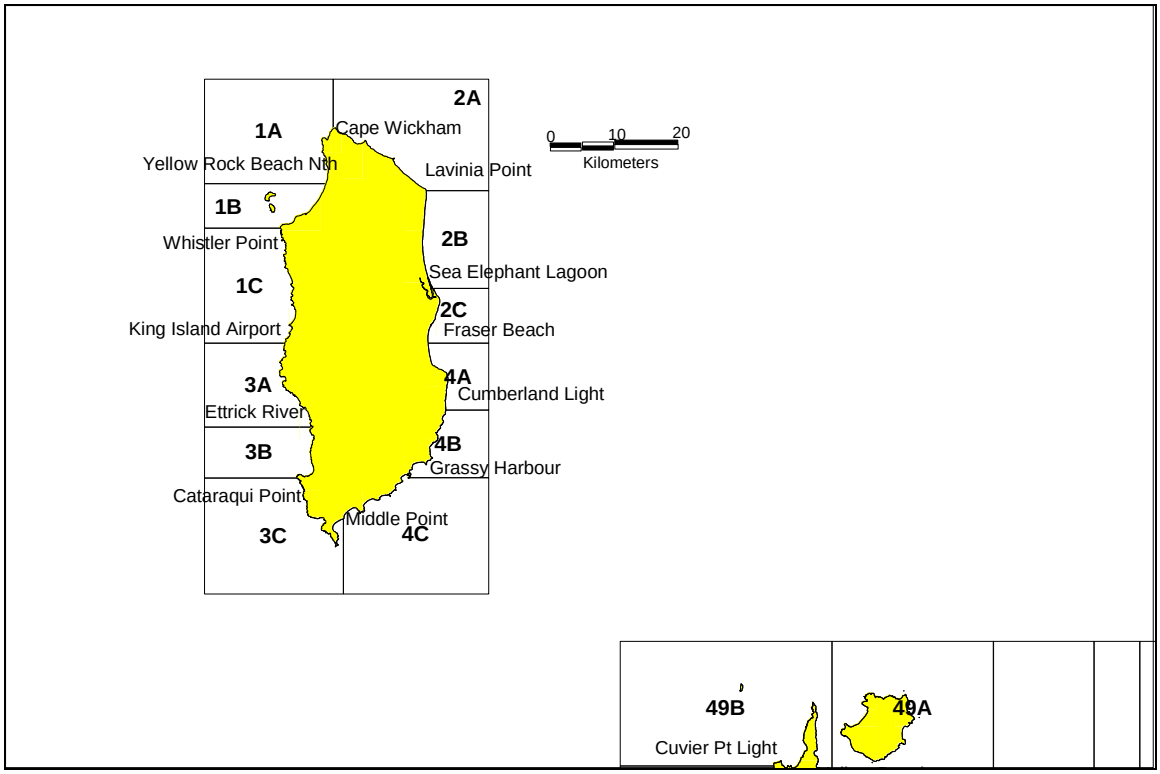
2006	Eastern Zone TAC remained 770t (220kg/unit) Western Zone TAC remained 1260t (360kg/unit) Northern Zone TAC remained 280t (80kg/unit) Greenlip TAC remained 122.5t (35kg/unit) Bass Strait Zone TAC remained 70t (20kg/unit) Fishery production was set at 2502.5t (715kg/unit) state-wide. On 1 January 2006, interim reduction in MSL for Perkins Bay greenlip area (Blocks 47, 48A), from 145 mm to 140 mm. On 20 September 2006, MSL for Bass Strait Zone in Blocks 41-46 (North Coast) reduced from 114mm to 110mm. On 1 November 2006, MSL for Eastern Zone was increased to 138mm from 136mm. MSL for greenlip abalone in Perkins Bay was reduced to 132mm from 140mm. As a temporary measure to facilitate research, Block 30 was entirely closed to commercial abalone fishing and partially closed (except sub-block 30A) to recreational abalone fishing. The bag limit for recreational fishers in sub-block 30A reduced to 5 abalone per day. May 2006: Victorian ganglioneuritis (AVG) outbreaks reported from wild stocks adjacent to land-based aquaculture site at Port Fairey. As a precautionary measure, the Tasmanian wild fishery in Bass Strait closest to the Victorian coast was closed to abalone fishing, from 16 August 2006, initially for three months but then extended to 28 February 2007. The closure was for waters within latitudes 39º 12' S and 39 º 33' S, and longitudes 146 º to 147 º 35' (Blocks 51 to 56, and part of Block 57, including Wright Rock and Endeavour Reef). The taking of abalone in Tasmanian waters from vessels used in the Victorian fishery was prohibited, and the transfer by sea of abalone from King Island to the Tasmanian mainland was prohibited.
2007	Eastern Zone TAC remained 770t (220kg/unit) Western Zone TAC remained 1260t (360kg/unit) Northern Zone TAC remained 280t (80kg/unit) Greenlip TAC remained 122.5t (35kg/unit) Bass Strait Zone TAC remained 70t (20kg/unit) Fishery production was set at 2502.5t (715kg/unit) state-wide. However, it was agreed that the Bass Strait component (70t) would not be caught due to concerns about disease outbreaks (AVG) in abalone stocks in adjacent Victorian waters. In October 2007, it was agreed that the cap for the southern part of the Actaeons (Sub-blocks 13C, 13D and 13E) would be reduced from 350t to 266t, and that a cap of 245t be implemented for the South Coast (Sub-blocks 12B, 12C, 12D, 13A and 13B).

2008	Eastern Zone TAC increased to 808.5t (231kg/unit) Western Zone TAC remained 1260t (360kg/unit) Northern Zone TAC increased to 332.5t (95kg/unit) Greenlip TAC remained 122.5t (35kg/unit) Bass Strait Zone TAC remained 70t (20kg/unit) The total catch state-wide was set at 2,593.5t, or 741kg/unit. As part of a controlled trial in the North West, size limits in Block 5 and part of Block 6 were reduced for divers meeting defined operating requirements on the basis that there were large stocks of fish too small to catch at the larger size limit, and that removing these smaller fish would promote growth among the remaining fish. The MSL in the Northern Zone part of Block 5 (5A, 5B and 5C) was reduced from 132mm to 127mm, and in sub-blocks 5D, 6A, 6B and 6C, from 136mm to 132mm. To promote fishing in the Northern Zone part of Block 5, the cap was increased from 100t to 152.5t and the Northern Zone TAC increased to 332.5t. The remainder of the Northern Zone was capped at 180t. In Bass Strait, south of 39° 33', the Bass Strait Zone was reopened to fishing on 1 January 2008. North of this line, all islands in the Bass Strait Zone remained closed to fishing as part of measures to reduce the spread of AVG from Victoria. The closed area included the Kent, Hogan and Curtis Groups. It was reopened to fishing on 6 July 2008. Fears of an outbreak of AVG resulted in the closure of the Lower Channel (sub-blocks 14A, 14B, 14C and 14D) to abalone fishing between 16 September 2008 and 12 March 2009. The area was reopened after extensive sampling and testing failed to find diseased abalone. Actaeons (Blocks 13C, 13D, 13E) closed to fishing for the remainder of the year from 21 October because the 266t catch limit had been reached (340t). South Coast closed to fishing on 29 October because the 245t catch limit had been reached (332t).

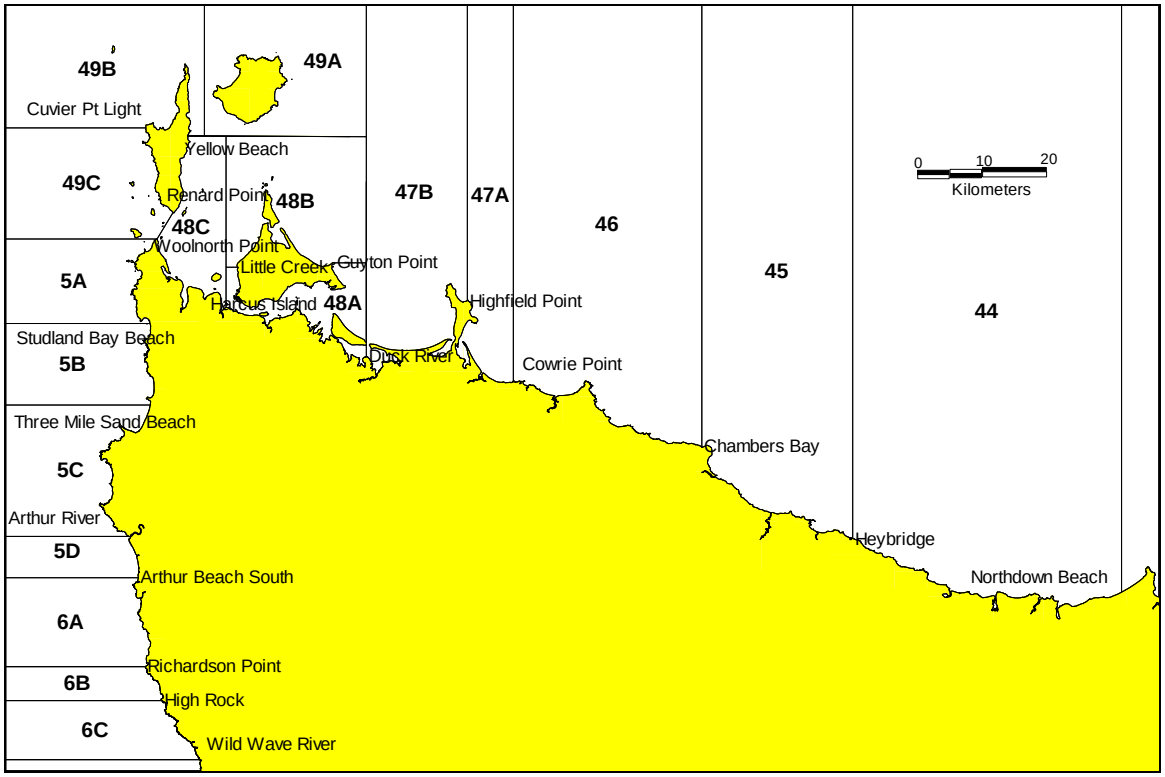
Appendix 11. Maps of catch-reporting blocks and sub-blocks.

It is not intended that these maps be used for any purpose other than identifying the position of sub-blocks mentioned in this report.

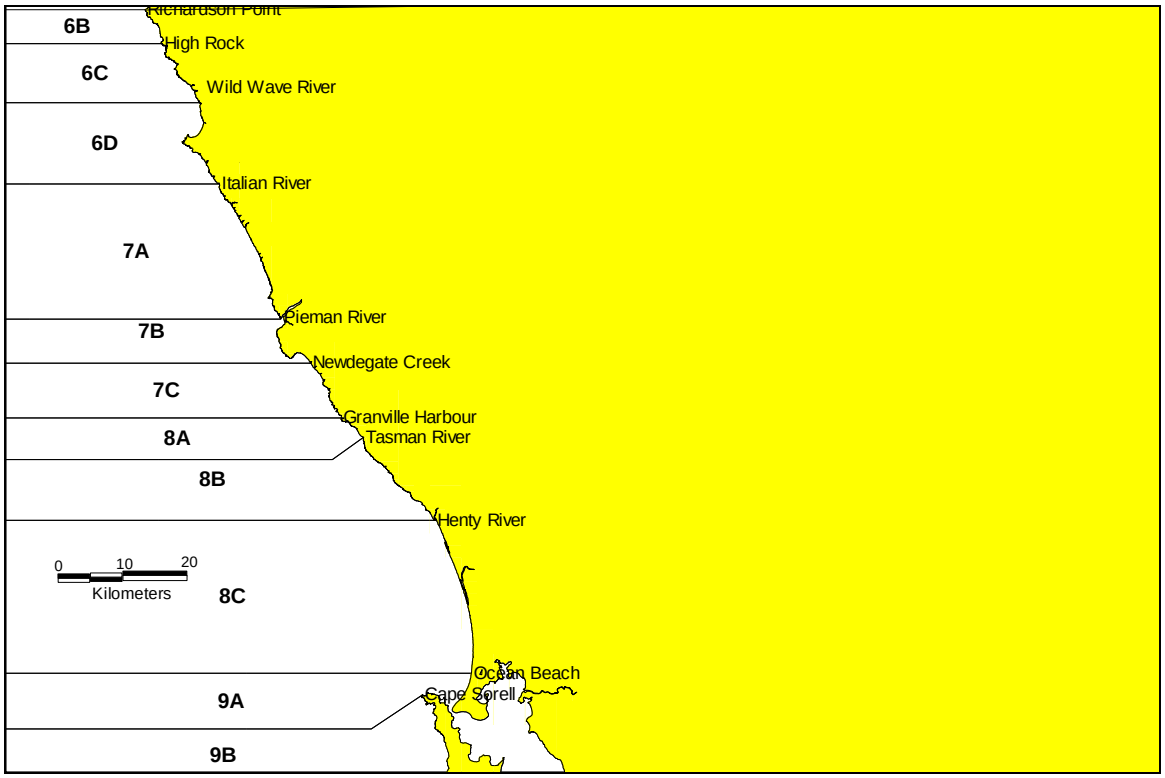
Map1: King Island



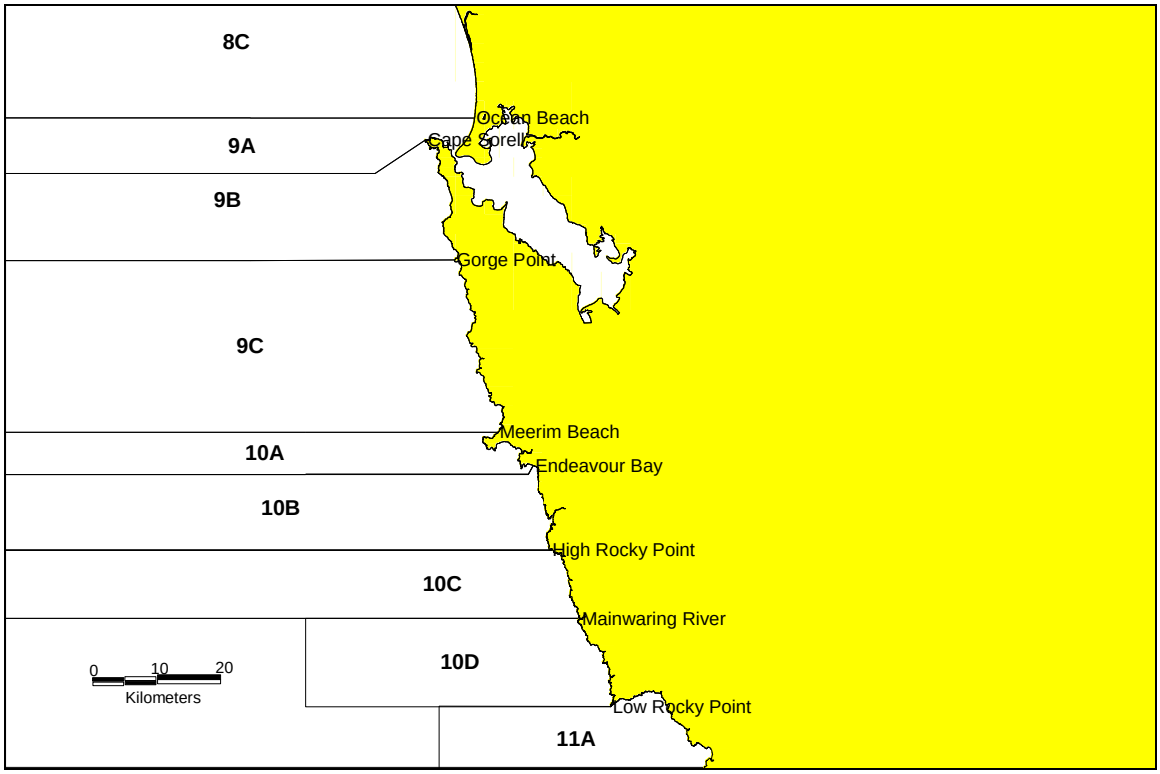
Map 2: North West Tasmania



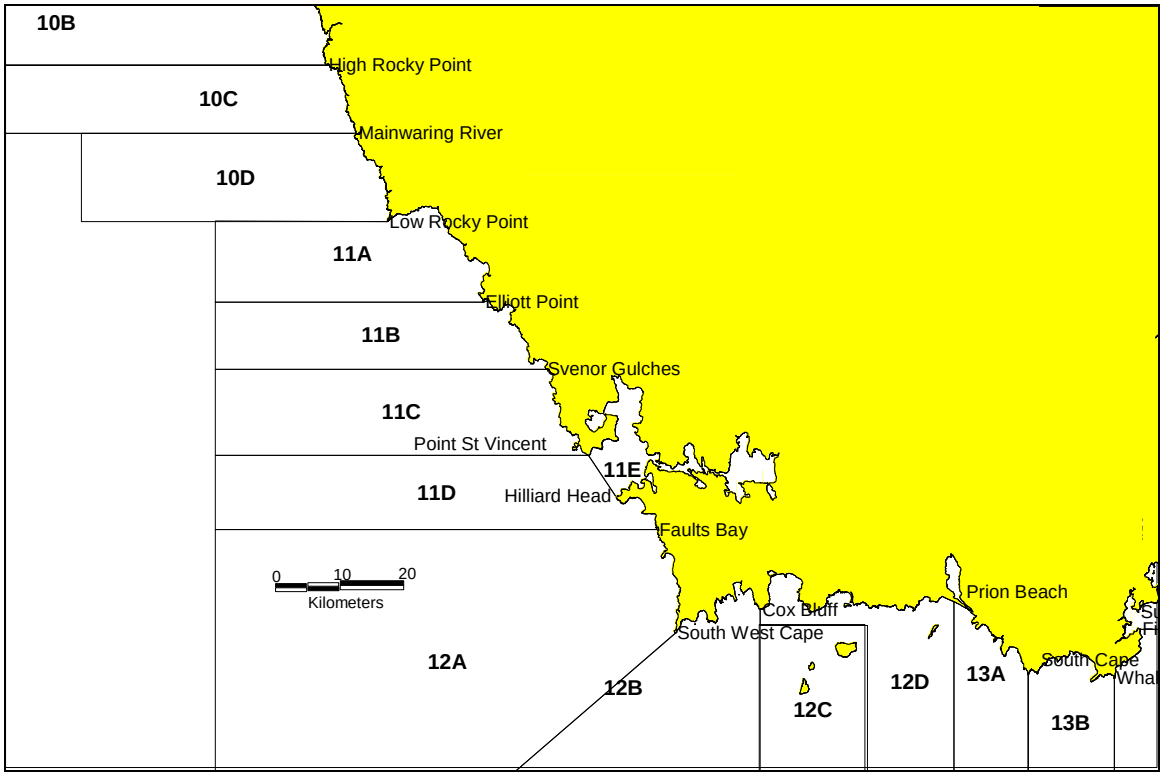
Map 3: Central West Coast (north)



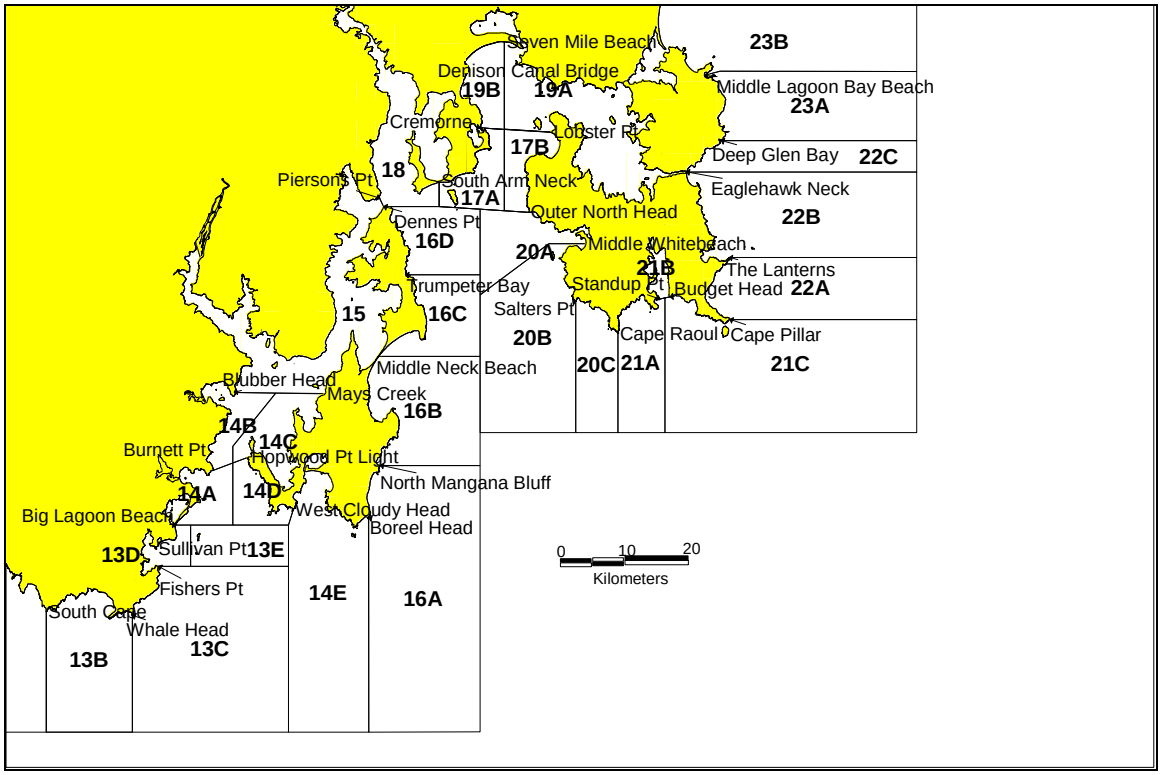
Map 4: Central West Coast (south)



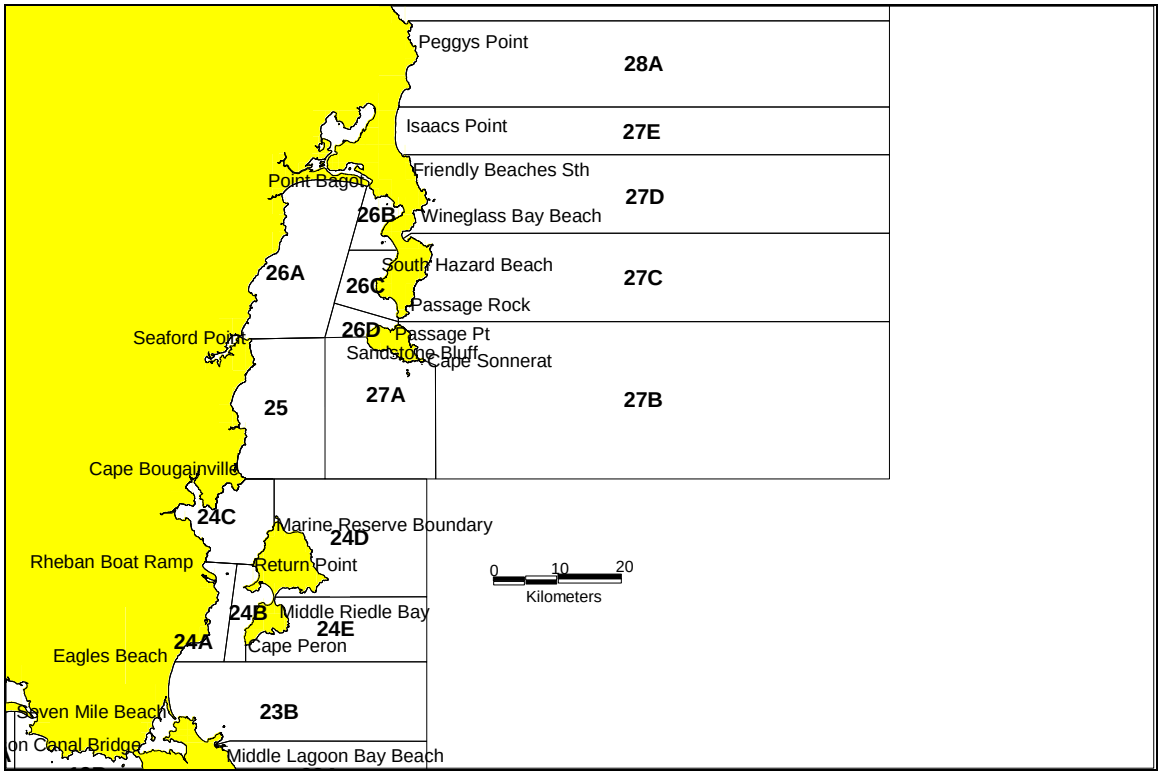
Map 5: South West Tasmania



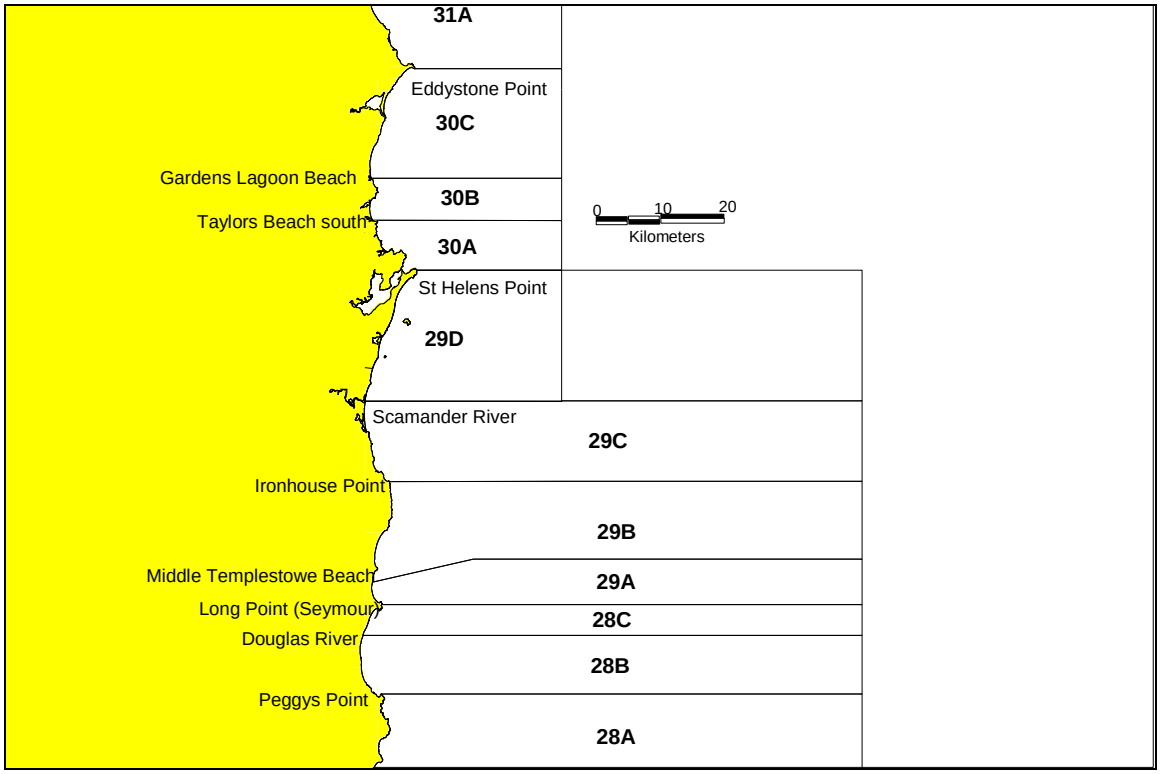
Map 6: South East Tasmania



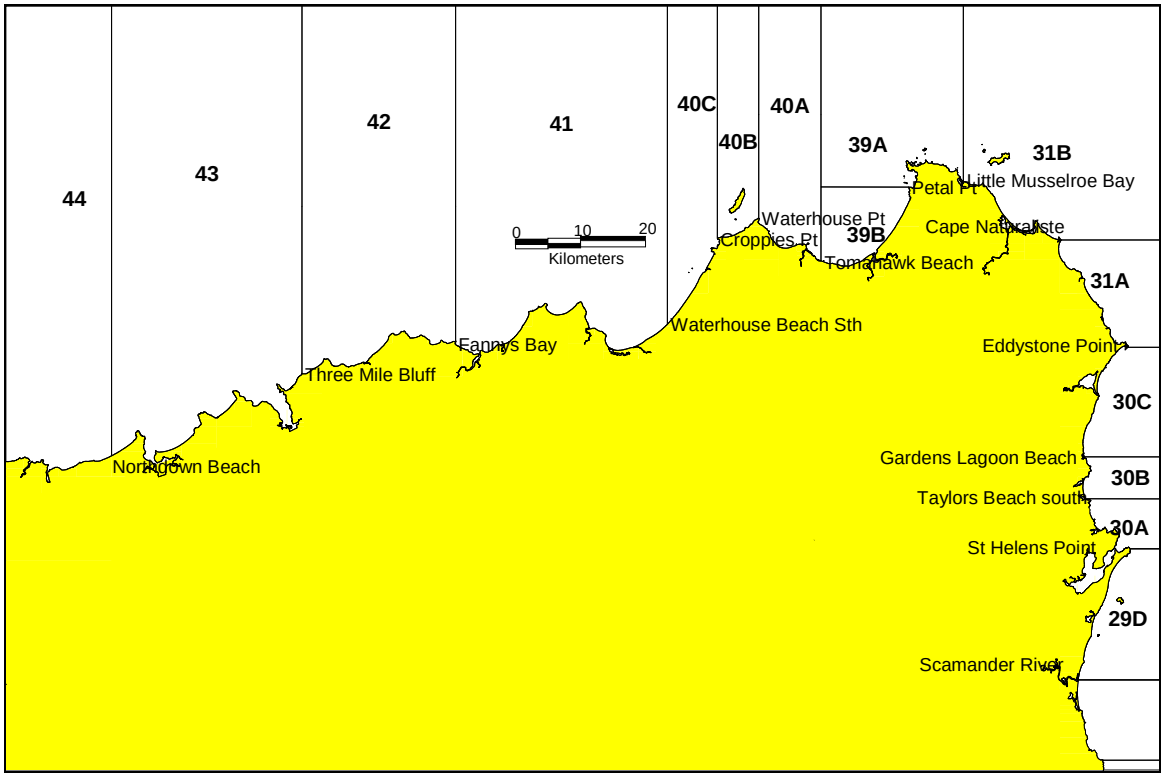
Map 7: Lower East Coast



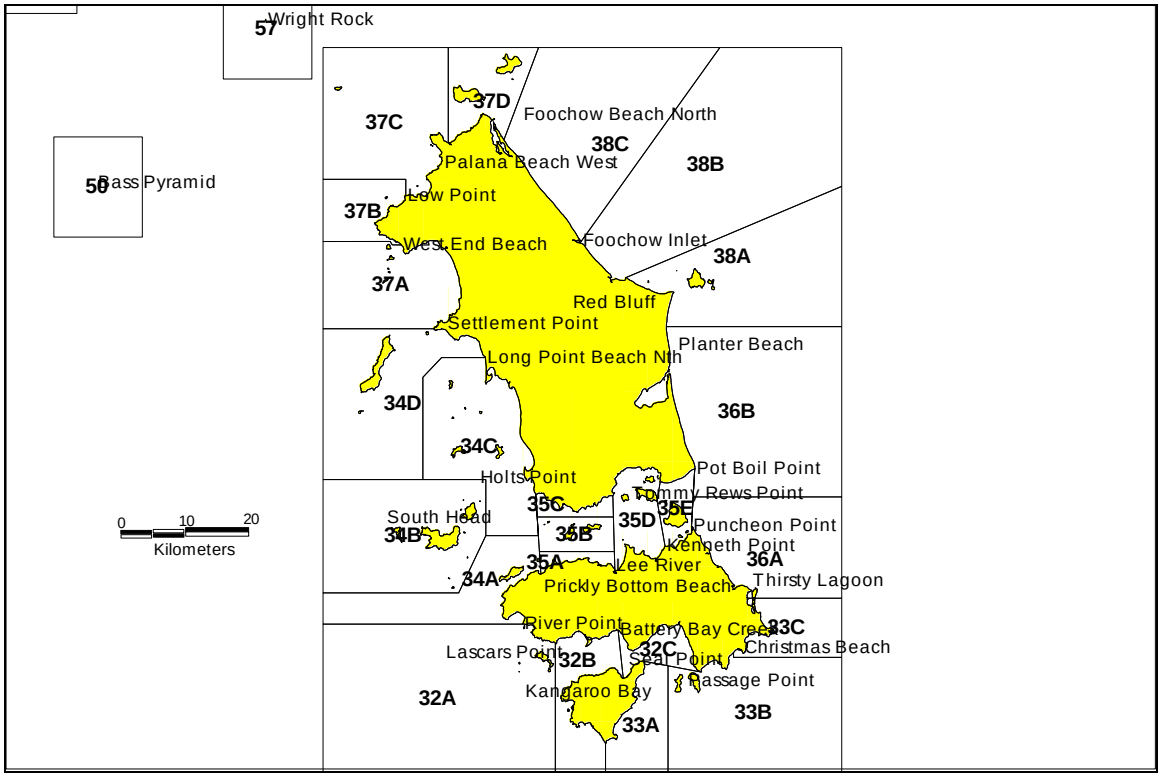
Map 8: Upper East Coast



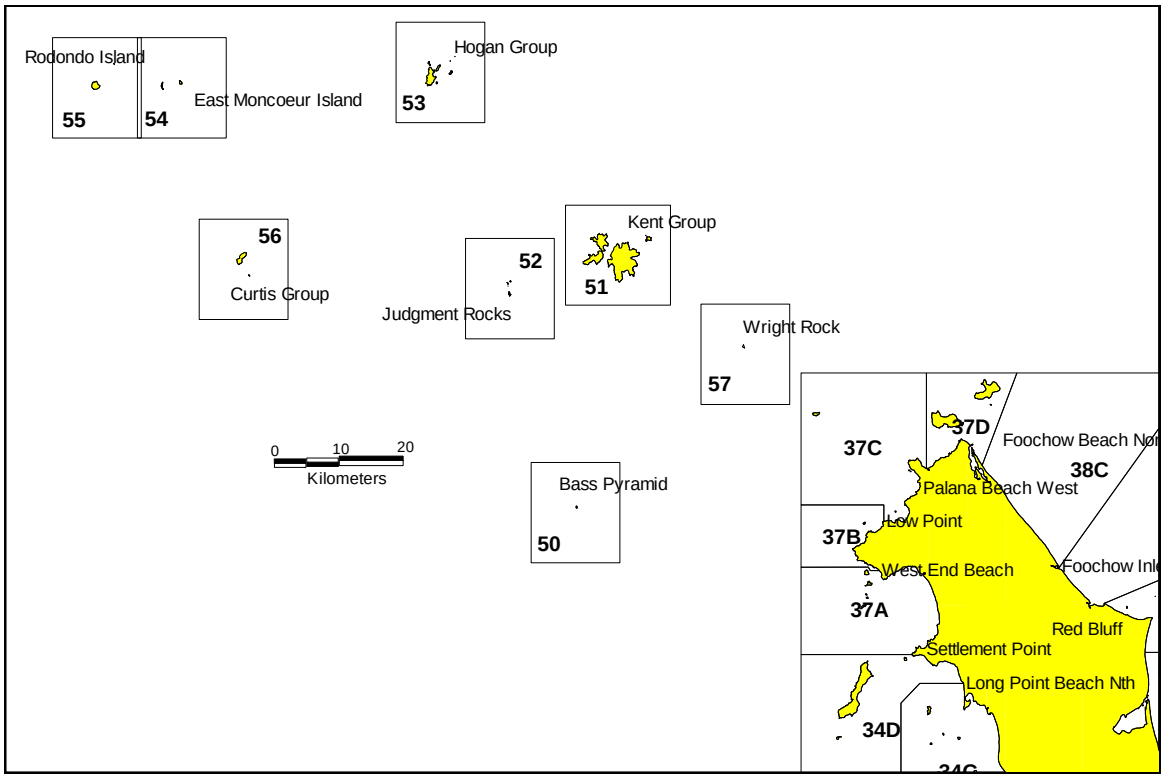
Map 9: North East Tasmania



Map 10: Furneaux Group

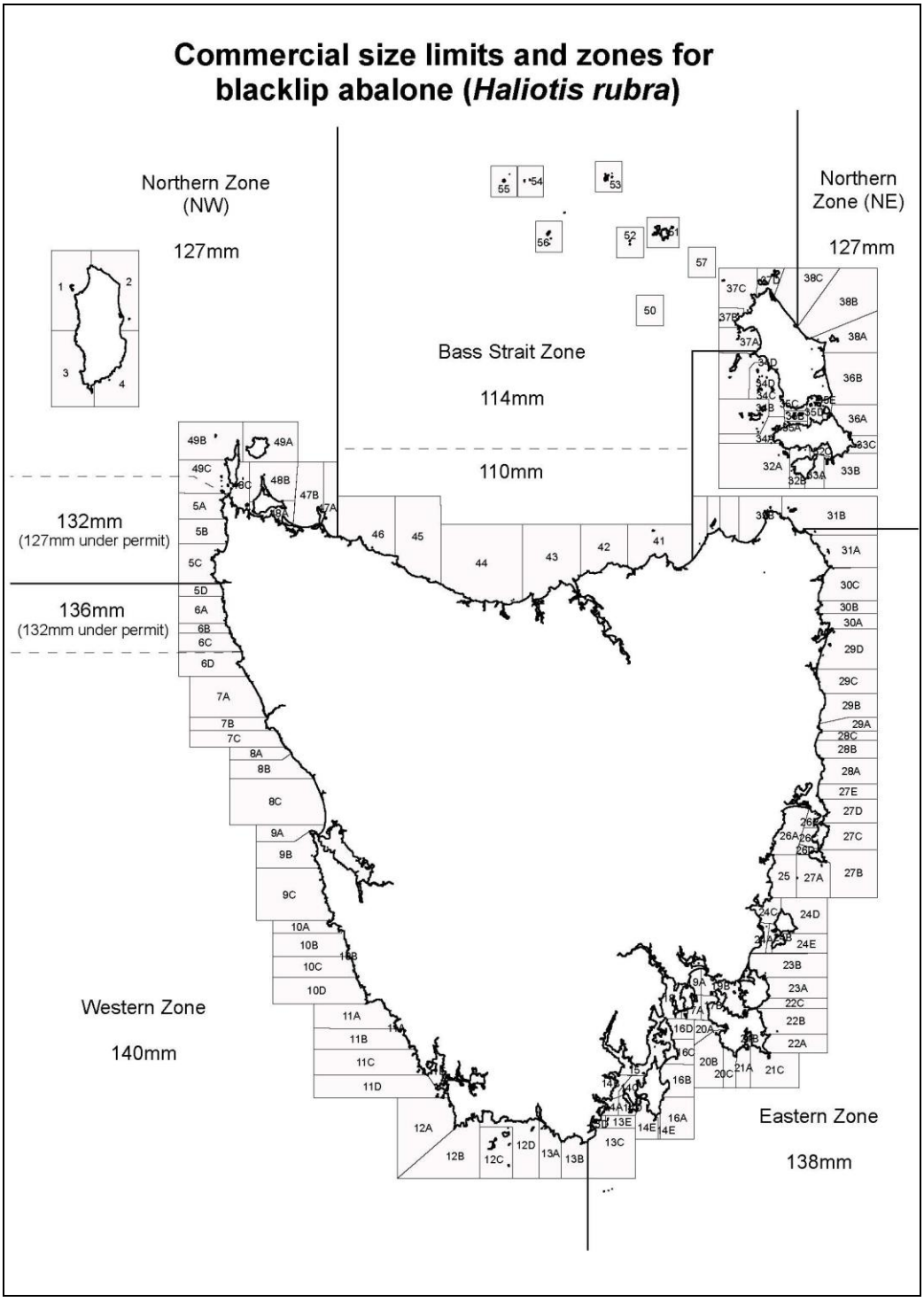


Map 11: Bass Strait Islands

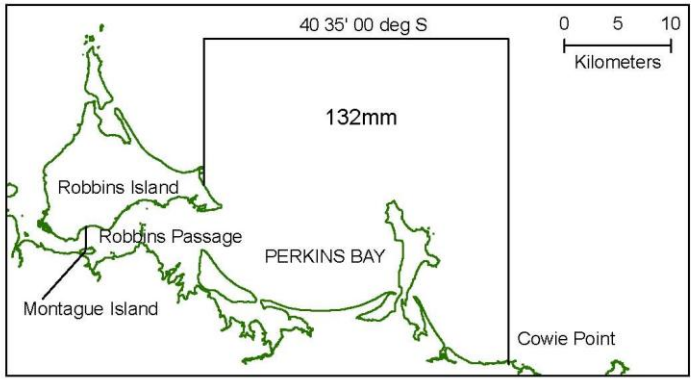


Appendix 12. Commercial Size Limits for blacklip and greenlip abalone, 2008

A management rule introduced in 2007 enabled abalone to be taken at reduced size limits under special permit in north-west Tasmania in 2008. All other size limits remained unchanged from previous years.



Commerical size limits for greenlip abalone (*Haliotis laevigata*)



King Island

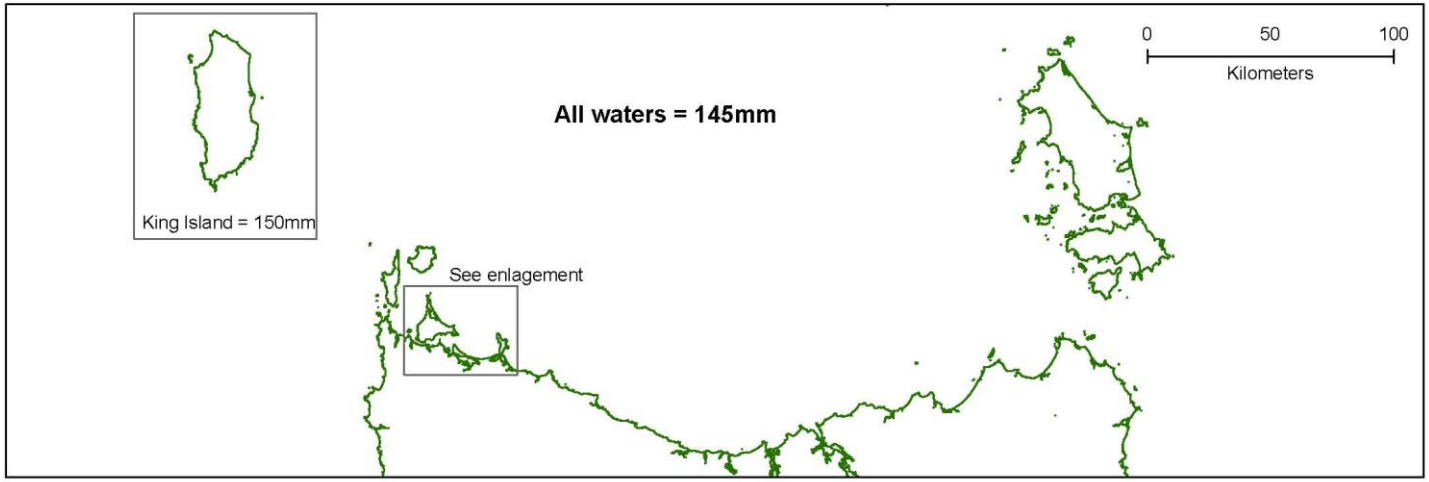
- All fish taken from King Island waters 150mm or greater.

Perkins Bay

- A 132mm size limit applies in Perkins Bay which is defined by waters which are enclosed with the following boundaries:
  - N/S of Montagu Island in Robbins passage to Cowrie Pt. and to a northward extent of 40 35' 00 deg S. to a western extent of 145 02' 52 E.

All other waters

- A 145 mm size limit exists for all other state waters for the take of greenlip abalone.



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A meeting of the Abalone Stock Assessment Working Group was held in February 2008, with smaller port meetings held in both Smithton and Scamander. We would like to thank the divers who attended these meetings for their advice. We also sought and received advice about stock levels from a number of other divers who were unable to attend our meetings, and whom we would like to thank for the time and help that they provided to us.

We also wish to acknowledge help, advice and input from Craig Mundy, TAFI, and the provision of financial summary information by Lyn Bailey, DPIW.